JUNE 1960

Precision Metal Molding

INCLUDING DIE CASTINGS MAGAZINE

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PMM

The magazine for design, finishing and the use of:

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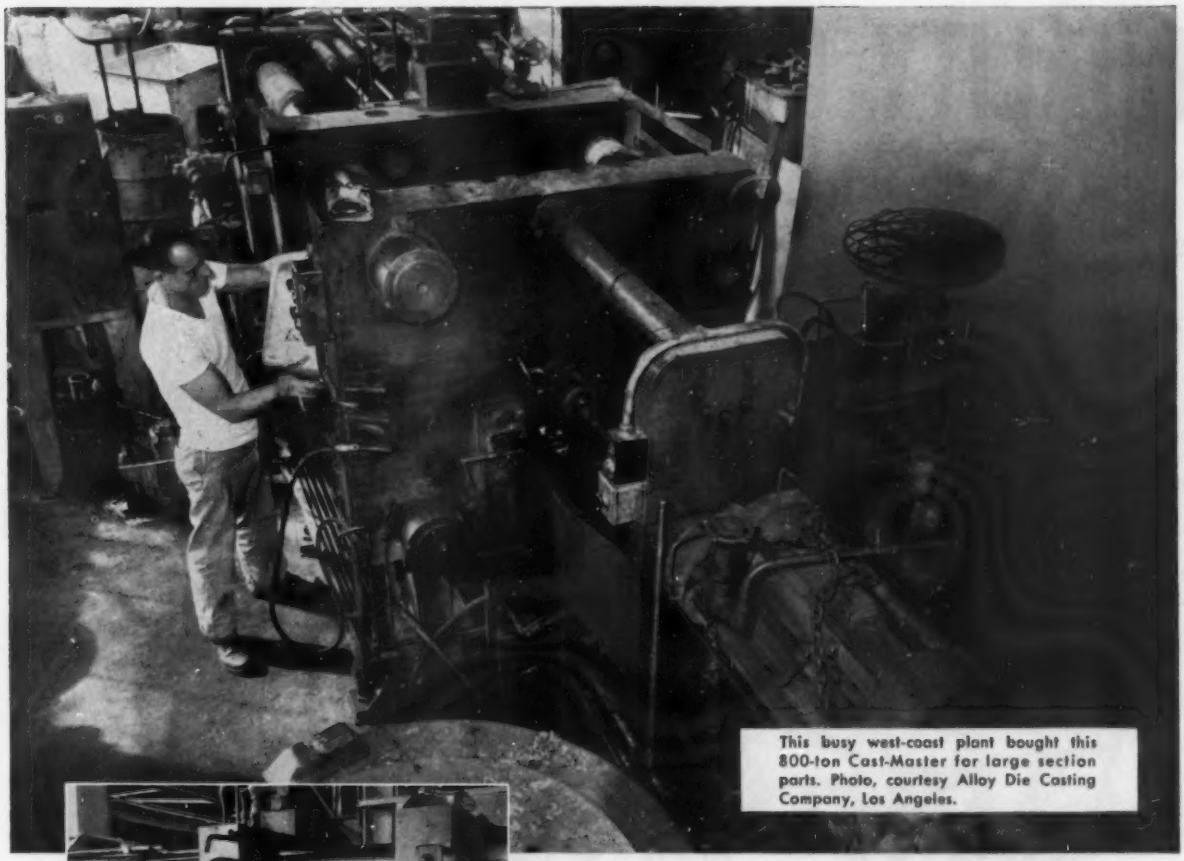
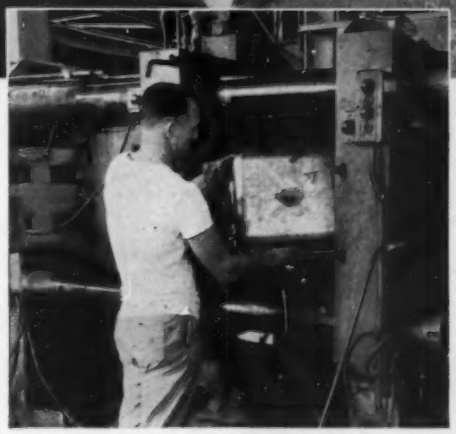


This busy west-coast plant bought this 800-ton Cast-Master for large section parts. Photo, courtesy Alloy Die Casting Company, Los Angeles.



Big, husky, thick section parts with accurate detail and true conformity to close tolerances. These machines are adjustable to all variables within its size range.

FOR BIGGER DIE CAST SECTIONS

If you're moving up into large section die castings, as typified by these views taken at Alloy Die Casting Company, Los Angeles, this 800-ton Cast-Master has much to offer. Exceedingly versatile, for so large a machine, you can rely on it for more and better die castings for an unlimited variety of jobs. This machine, or any of the Cast-Master line from 100-ton up to 2000-ton clamping force, can modernize your plant for top production. Get the facts, today. Hot or cold chamber types with interchangeable injection ends, doubles the utility of the Cast-Master machine.

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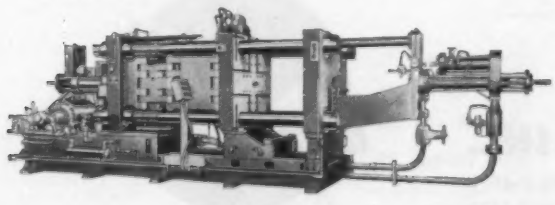

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CORROSION PROBLEMS:

can moly metal's resistance to mineral acids solve them for you?

The following tables show molybdenum's resistance to corrosion by mineral acids, providing oxidizing agents are not present. They also indicate molybdenum's superiority to conventional materials used in handling these acids.

hydrochloric acid

% HCl	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	14% Si – 3% Mo iron	70% Ni – 30% Mo alloy
5	room	yes (air)	0.40	–	7.8
		yes (oxygen)	0.27	–	–
	160	no	1.1	18.	13.
		yes (oxygen)	1.4	17. (air)	25. (air)
	boiling	no	3.6	79.	13.
20	room	yes (air)	0.10	–	3.1
	160	no	0.58	35.	9.2
		yes (oxygen)	1.4	53. (air)	24. (air)
	boiling	no	0.90	230.	27.
37	room	yes (air)	0.16	–	1.6

*average of five 48-hr periods

hydrofluoric acid

% HF	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	70% Cu – 30% Ni alloy
25	room	no	0.13	2.6
		yes (air)	0.22	–
	212	no	3.1	55.
		yes (air)	20.	–
49	room	no	0.14	4.1
		yes (air)	0.08	–
	212	no	2.3	75.
		yes (air)	16.	–

*average of five 48-hr periods

phosphoric acid

%H_3PO_4	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	type 316 stainless steel	70% Ni – 30% Mo alloy
10	room	yes (air)	0.27	nil to 0.18** (oxygen)	1.7
	212	no	2.4	nil to 0.18**	24.
	boiling	no	1.3	nil to 6.7**	19.
50	room	yes (air)	0.25	nil to 0.06** (oxygen)	0.40
	212	no	1.5	1.7	2.5
	boiling	no	1.5	5.4	7.1
85	room	yes (air)	0.20	nil to 0.80** (oxygen)	0.16
	212	no	0.29	20.	0.83
	boiling	no	1.4	770.***	1.9

*average of five 48-hr periods
**range of five 48-hr periods
***one 48-hr period only

sulfuric acid

%H_2SO_4	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	14% Si iron	14% Si – 3% Mo iron
10	160	yes (nitrogen)	0.22	–	–
		yes (air)	1.4	–	–
		yes (oxygen)	nil to 9.1**	–	–
	boiling	no	6.6	–	–
	400	no	0.77	–	–
20	160	yes (nitrogen)	0.18	–	–
		yes (air)	0.82	–	–
		yes (oxygen)	nil to 3.4**	–	–
	400	no	3.7	–	–
40	160	no	0.74	11.	2.9
		yes (air)	nil to 0.90**	10.0	–
		yes (oxygen)	nil to 1.4**	–	–
	boiling	no	1.5	14.	6.7
50	160	no	0.52	3.4	0.36
		yes (air)	nil to 0.52**	2.3	–
	boiling	no	2.5	5.9	1.6
75	160	no	0.70	0.13	0.20
		yes (air)	nil to 0.15**	nil	–
	boiling	no	34.	0.26	0.68
95	160	no	0.12	0.02	0.28
		yes (air)	nil to 0.21**	0.36	–
	boiling	no	dissolved	–	–

*average of five 48-hr periods
**range of five 48-hr periods

Molybdenum also offers good long-term resistance to attack by liquid metals up to the temperatures given: bismuth (2600 F), gallium (570 F), lead (2190 F), lithium (1650 F), magnesium (1290 F), mercury (1110 F), potassium (1650 F), sodium (liquid and vapor) (1650 F), sulfur (825 F) – and a number of alloys of these and other metals.

FORGING BILLETS OF CLIMELT MOLYBDENUM METALS AND CLIMELT MOLYBDENUM-BASE ALLOYS ARE NOW PROMPTLY AVAILABLE IN STANDARD STOCK SIZES OF 4⅛", 5½", 6", 6½" AND 7" DIAMETERS. BAR STOCK IS MAINTAINED IN A RANGE OF SIZES UP TO 4" DIAMETER.

For complete data, send for these free manuals: "Corrosion Resistance of Molybdenum and Molybdenum-Base Alloys" (24 pages), "Molybdenum Metals" (110 pages), and "Climelt Molybdenum and Molybdenum-Base Alloys" (24 pages). Write:

CLIMAX MOLYBDENUM COMPANY

A division of American Metal Climax, Inc. / 1270 Avenue of the Americas, New York 20, N.Y.

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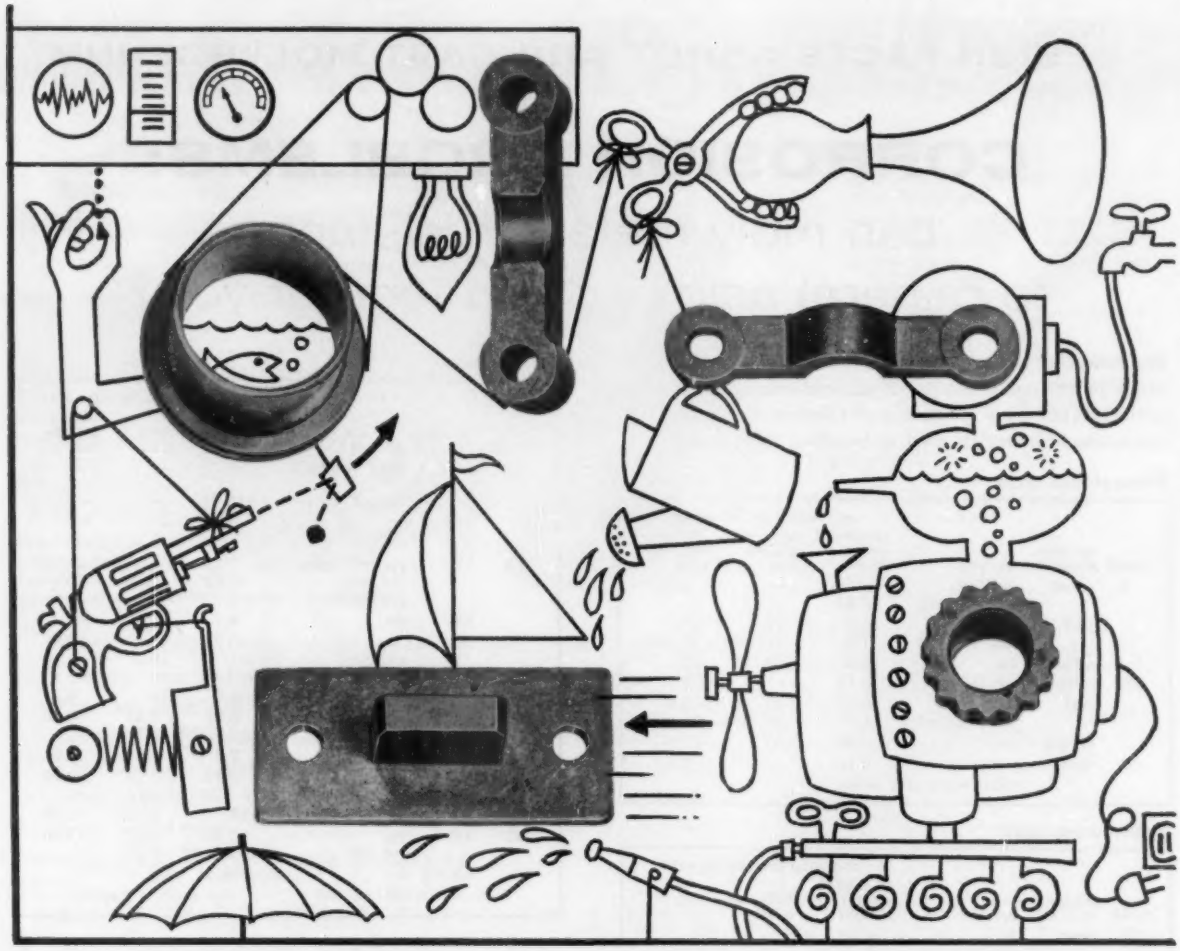

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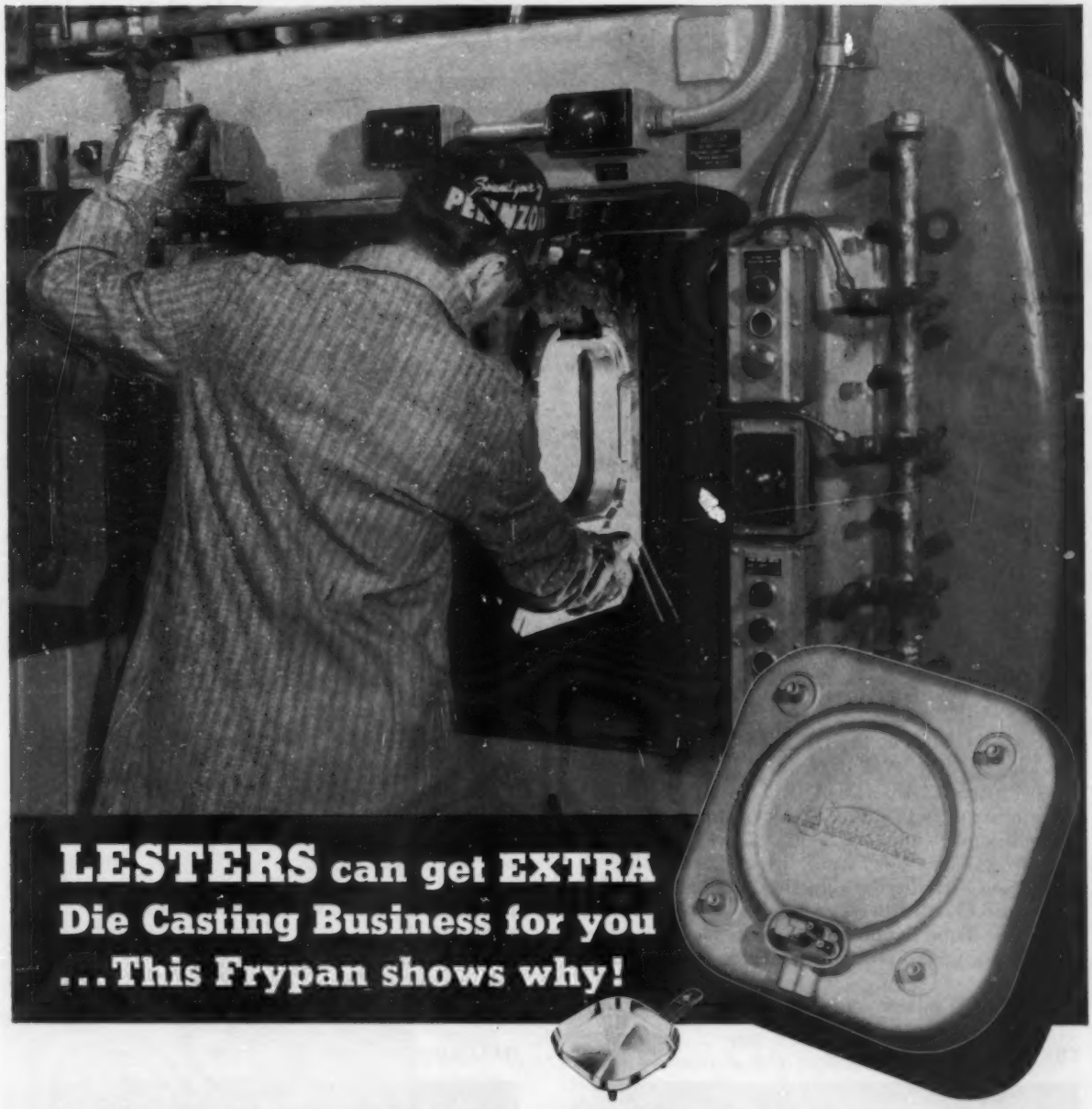

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Specifications: 121 square inches, heating element insert, absolute non-porosity to resist frying temperatures, and flawless finish. And to top it off, it had to be cast with No. 360 prime alloy, to provide the finest non-corrosive utensil. As you know, it's one of the toughest alloys to cast.

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Sunbeam Corporation has been so very impressed and pleased that they have ordered Lesters for their own plants, to assist in the production of the product.

Here's the clincher. Meta-Mold has been die casting for less than two years and has been out-performing more experienced vendors who don't use Lester machines.

Complete machine specifications available in Bulletin 101. WRITE TODAY.

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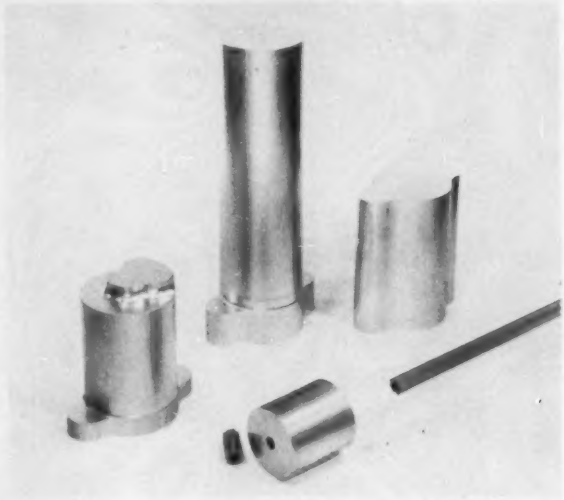
CASTING ABOUT

technical news of applications & process involving precision metal molding

ALUMINUM POWDER METALLURGY NOW MAY BE READY FOR APPLICATION

THROUGH THE USE OF POWDER METALLURGY, aluminum parts with exceptional high temperature strength can be made. The process has been in limited use in Europe for several years, but commercial use in this country has lagged. Now, impact extrusions made from slugs formed by powder metallurgy have been made by the Aluminum Company of America. Examples of parts made by the new process are shown in the illustration. The finned tube, for example, is ¼ in. in diameter, has 8 fins and a wall thickness tolerances of about 0.003″.

Other impacts made from sintered aluminum slugs are also shown in the illustration. While the first applications of the process will probably be in the nuclear, aircraft, and missile fields; Alcoa engineers believe there is a large industrial market for these products. Wherever the corrosion resistance of aluminum is needed together with good strength at elevated temperatures, these products should be useful.



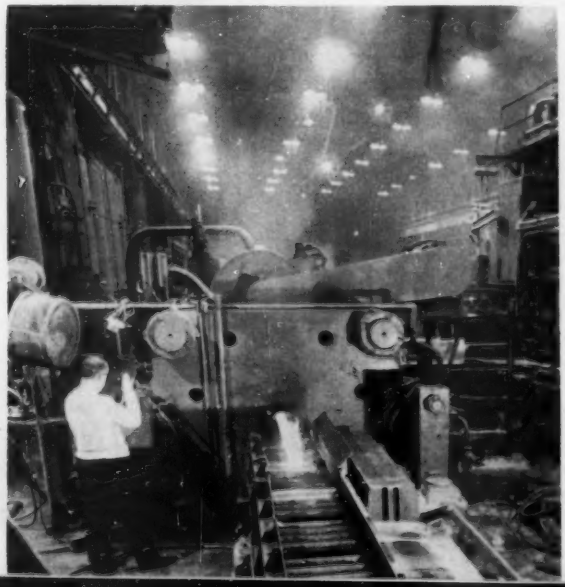
EXTRUSION HELPS MAKE LARGE DIAMETER, LONG ZIRCONIUM TUBES

IT TAKES THE COMBINED TALENTS of three large companies to make Zircaloy-2 tubes 3¼″ OD x ¼″ wall x 57′ minimum length. The companies, Allegheny Ludlum Steel Corp. which casts, rolls, machines and extrudes the alloy into tubes about 4″ OD. The Budd Co. then welds the tubes in a dry box and finally the Tube Reducing Co. works the 40′ long sections down to the required diameter, wall thickness, and length.

Allegheny Ludlum compacts zirconium sponge into slugs and welds the slugs together to form an electrode. The ingots are melted in a vacuum arc melting furnace. Ingots from vacuum melting, after chemical and mechanical testing, are forged to 8″ square billets and are later rolled to 7″ billets. The final billet is machined to extrusion diameter, are copper clad, and then extruded.

Straightening of the extruded tubes is done on a roll-type straightener. The copper is etched off with nitric acid, the tubes bright pickled, and inspected.

THE TUBES are extruded, then . . .



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Medium in size!
Large in performance!

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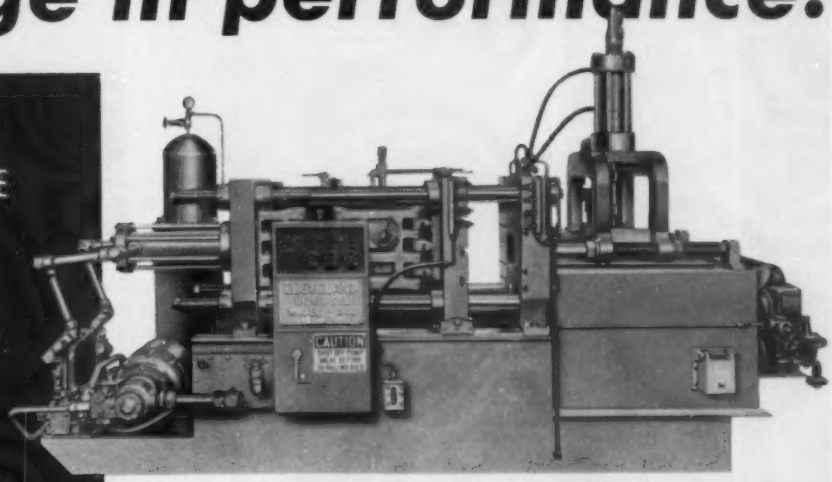
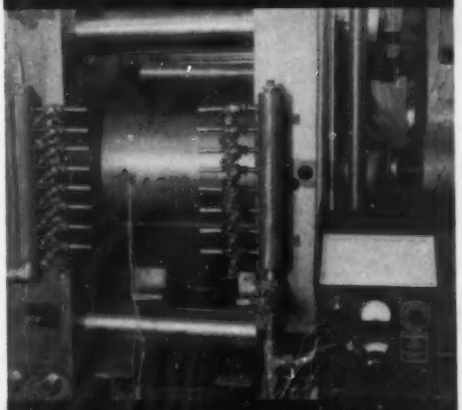
★ Certified by Independent Research Laboratory personnel *(H. C. Nutting Co.)*

★ Test results filed with the Society of Die Casting Engineers





★ Cleveland Die Casting Machine being tested for clamping capacity using SDCE calibrated test ring method.

All machines are strain gauge tested and conservatively rated under actual locking pressure. *This 200 ton machine actually tested 274 tons by the SDCE test.*

200 TON CLEVELAND
DIE CASTING MACHINE

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THE CURIOUS CASE OF INTERMITTENT HARDNESS

Another costly mystery—solved by the man from Kaiser Aluminum

THE PUZZLING FACTS. A manufacturer of aerial camera brackets recently found himself in a quandary. An intermittent hardness condition had developed on his castings made from aluminum alloy 2356-T6. This adversely affected the finish of the casting, shortened tool life, and increased machining time.

HOW THE CASE WAS SOLVED. What was the trouble? Upon personal investigation, the man from Kaiser Aluminum found it to be a combination of (1) inadequate furnace temperature control, (2) poor heat treating results due to varying delays before quenching and aging of castings. As soon as these procedures were corrected, production returned to normal.

WE LOVE A MYSTERY. This is one of many actual cases solved by Kaiser Aluminum working with a customer. Perhaps *you* have a mystery one of our technical engineers might help solve? He'll give you expert advice on any casting problem—including conversion from cast iron to aluminum, mold and die design, alloy selection, heat treatment, finishing, fluxing, metal transfer.

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FOR PIG AND INGOT with a free sleuthing bonus, call your nearest Kaiser Aluminum sales office or any of the distributors listed on the opposite page. Or write to: Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

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PMM LETTERS

the readers' forum

DIE VS. PLASTER CASTING

In a product which we are making, we use a small brass base similar to a small candle-stick base. We now import them from Japan.

We are interested in getting this made domestically. We believe it should be either die cast or plaster mold cast. Since we would only want about 1000 at a time, probably plaster mold casting would be more practical.

We would appreciate your giving us the names of some firms who might be interested in making these.—J.W.G. pres.

The names of several companies who can make either plaster mold castings or brass die castings have been furnished to this reader. Probably, if the tooling charges are not too high, die castings in brass might compete with plaster mold casting. —Ed.

EUROPEAN D. C. AFFILIATION

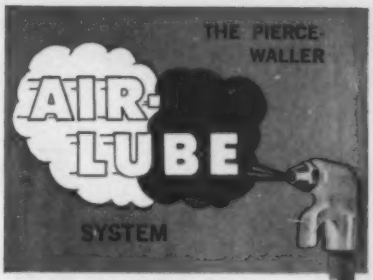
At the present time we represent a rather small sized die casting plant established in the Paris area. We are supplying our customers in Paris and elsewhere in France with all kinds of die castings in both aluminum and zinc alloys.

Recently we bought an important industrial complex on the Normandy coast in order to develop our production potential and thus to face, with a better chance, the European Common Market now in formation.

We noticed that a certain number of U.S. firms are now creating European subdivisions under various forms and particularly in association with existing European companies. We would like to point out, in this respect, that our government has given all necessary appeasements to foreign firms who invest money in France for free transfer of commercial profits.

Our request to you would be to bring us into contact with U.S. die

continued on page 28



CUTS COSTS for DIE-CASTERS

- CLEANS
- LUBRICATES

Remove loose flash and clean the mold with a powerful, clean air blast — then lubricate all mold surfaces evenly, *using the same gun* —with a flick of the thumb! Adjustment *at the gun* for full range from zero to a heavy mist, spraying, fogging, or vaporizing the lubricant. Speeds up mold operation and reduces casting rejects. Makes every machine cycle count.

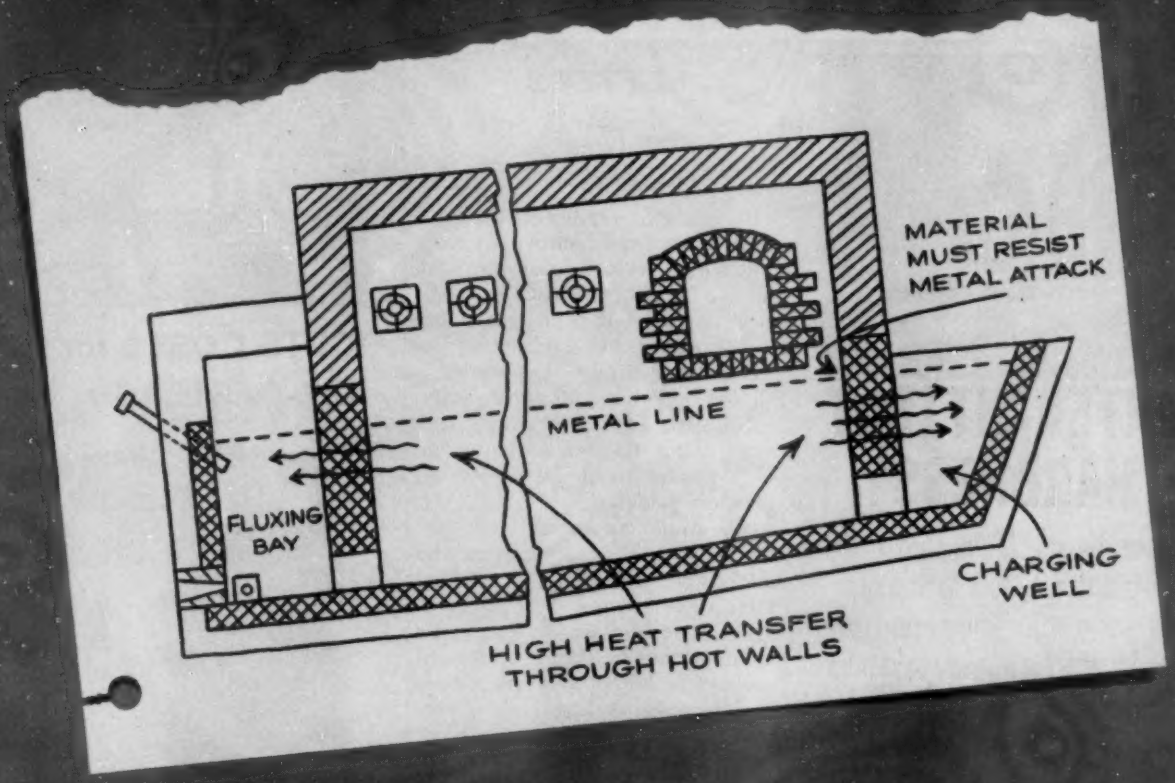
USED IN LARGE AND SMALL SHOPS EVERYWHERE!

WRITE FOR FREE FOLDER

PIERCE-WALLER, INC.

P. O. Box 2121A • DAYTON 29, OHIO

Circle No. 70 on Reader Service Card



Design hints on refractories for aluminum furnaces

Hot-wall construction facilitates melting and refining

The aluminum melting furnace sketched above capitalizes on the advantages of high thermal conductivity material in the hot walls to facilitate melting and refining.

The hot walls, built of CARBOFRAX® M silicon carbide brick, transmit heat to the charging well and fluxing bay 12 times faster than fireclay. In addition to superior heat conductivity, CARBOFRAX brick have the necessary structural and physical properties to withstand penetration, attack and corrosion by molten aluminum, thus extending furnace life. The walls are also easy to clean and maintain.

Special-purpose refractories made by Carborundum offer a choice of materials to meet widely varying needs in all critical areas of aluminum melting furnaces.

CARBOFRAX *ceramic-bonded silicon carbide,* for example, is made in a variety of compositions suitable for hot walls, side walls, bottoms, charging ramps and door jambs and sills. REFRAX® *silicon-nitride-bonded silicon carbide* can be supplied in accurately dimensioned shapes with high strength and resistance to thermal shock. It is not wet by molten aluminum. Applications include launders, troughs, spouts, tapout blocks, stoppers and pyrometer tubes. Special uses are found in furnaces subject to intermittent operation. ALFRAX® *fused alumina bubble insulating brick* are light in weight, withstand high temperatures and have the low heat transfer qualities needed in walls and roofs above the metal line. MULLFRAX® *electric furnace mullite* resists flame erosion and spalling, has low heat transfer. It is widely used for burner blocks.

For assistance and recommendations on how to engineer refractories to your specific furnace needs, contact Dept. R-60, Refractories Division, The Carborundum Co., Perth Amboy, N. J.

For engineered refractories . . . count on

CARBORUNDUM®

Circle No. 14 on Reader Service Card

Unmatched purity and uniformity:

FEDERATED ZINC DIE CASTING ALLOYS

Completely controlled production provides you with die cast metals of highest purity and uniformity. Federated Zinc die cast metal is made from ASARCO Special High Grade Zinc, electrolytically refined by Asarco-developed processes. Production is concentrated "under one roof" at Corpus Christi, Texas, one of the world's largest plants producing Special High Grade zinc and die casting alloys. Strategically located warehouse stocks assure you of prompt volume delivery. For complete information about FEDERATED Zinc Die Casting Alloys, write or call: Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y. or your nearby Federated sales office.

ASARCO

AMERICAN SMELTING AND REFINING COMPANY

Low machining costs, superior castability, and an excellent plating surface are the big reasons why zinc die castings are favored for fuel pumps, carburetors, grilles, lamp housing, instrument panels, horn rings, and many other functional and decorative automotive components.

FEDERATED METALS DIVISION

Where to call for information:

ALTON, ILLINOIS
Alton: Howard 5-2511
St. Louis: Jackson 4-4040

BALTIMORE, MARYLAND
Orleans 5-2400

BIRMINGHAM, ALA.
Fairfax 2-1802

BOSTON 16, MASS.
Liberty 2-0797

CHICAGO, ILL. (WHITING)
Chicago: Essex 5-5000
Whiting: Whiting 826

CINCINNATI, OHIO
Cherry 1-1678

CLEVELAND, OHIO
Prospect 1-2175

DALLAS, TEXAS
Adams 5-5034

DETROIT 2, MICHIGAN
Trinity 1-5040

EL PASO, TEXAS
(Asarco Mercantile Co.)
3-1852

HOUSTON 29, TEXAS
Orchard 4-7611

LOS ANGELES 23, CALIF.
Angelus 8-4291

MILWAUKEE 10, WIS.
Hilltop 5-7430

MINNEAPOLIS, MINN.
Tuxedo 1-4109

NEWARK, NEW JERSEY
Newark: Mitchell 3-0500
New York: Digby 4-9460

PHILADELPHIA 3, PENNA.
Locust 7-5129

PITTSBURGH 24, PENNA.
Museum 2-2410

PORTLAND 9, OREGON
Capitol 7-1404

ROCHESTER 4, NEW YORK
Locust 5250

ST. LOUIS, MISSOURI
Jackson 4-4040

SALT LAKE CITY 1, UTAH
Empire 4-3601

SAN FRANCISCO 24, CALIF.
Atwater 2-3340

SEATTLE 4, WASHINGTON
Main 3-7160

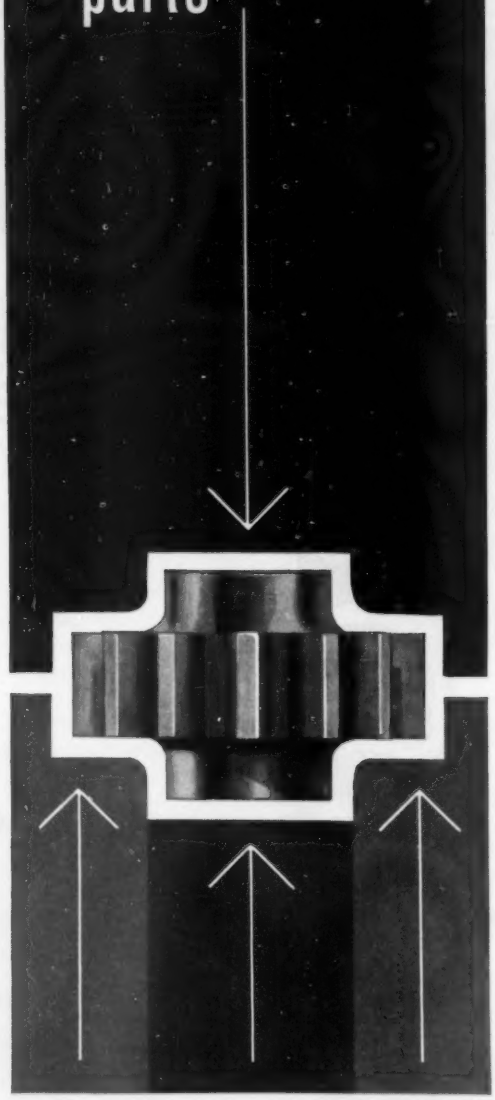
WHITING, IND. (CHICAGO)
Whiting: Whiting 826
Chicago: Essex 5-5000

IN CANADA: Federated Metals Canada, Ltd.
Toronto, Ont., 1110 Birchmount Rd., Scarborough, Phone: Plymouth 73246

Montreal, P.Q., 1400 Norman St., Lachine, Phone: Melrose 7-3591

Circle No. 7 on Reader Service Card

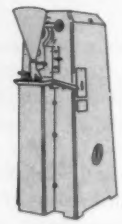
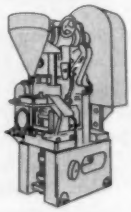
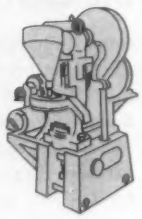
EXTRA MOTION for complex powder metal parts



Stokes answers the growing need for extra motions in the manufacture of more complex parts by adding three *new* machines to its extensive line of compacting presses. In each compacting press, the design of the secondary lower motion enables the operator to adjust timing, duration, and length of thrust independent of the mechanical timing of the preset main operating cycle of the press. The built-in secondary lower motions may be used as compacting punches or core-rods (stationary, movable, stripping, or ejection type).

These low and medium-pressure presses give you all the advantages you would expect to find in a Stokes press . . . accuracy, high production rates, ease of adjustment, and little maintenance . . . *plus extremely flexible lower motions.*

SINGLE-STATION MULTIPLE MOTION PRESSES

Model 572-1	Model 573-1	Model 574-1
4 TONS	12 TONS	20 TONS
		
4 TONS + 1 TON	12 TONS + 3 TONS	20 TONS + 5 TONS

For complete technical data on these single-station multiple motion presses, write for Data Sheet 126. Consult Stokes Engineering Advisory Service for complete technical assistance in designing parts, punches and dies, or complete production facilities.

STOKES

POWDER METAL PRESS DIVISION • **F. J. STOKES CORPORATION** • 5500 TABOR ROAD, PHILADELPHIA 20, PA.

Circle No. 46 on Reader Service Card

why new/improved Hotform

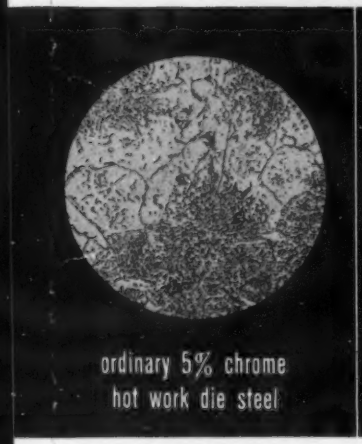
U. S. Pat. 2,893,902 July 7, 1959

offers unparalleled increases in die life and service—

corrects heat checking and cracking

study the story these photomicrographs tell:

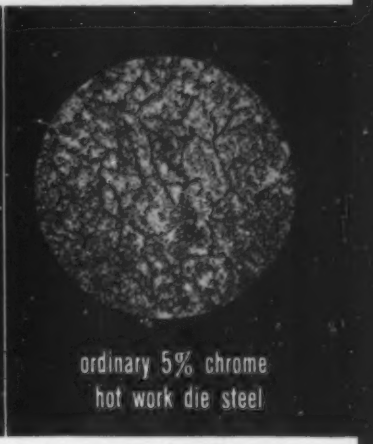
ANNEALED | **HEAT-TREATED ROCKWELL "C" 50**



Structure is typical of large sections of H-11, H-12 and H-13 type steels commonly on the market. Note carbide segregate and envelopes in grain boundaries. This structure persists through heat treatment to form lines of discontinuity that initiate cracks.

Note uniform distribution of pinpoint carbides—freedom from carbide segregate in grain boundaries—freedom from carbide stringers. This structure, guaranteed in New/Improved Hotform, increases toughness and ductility of heat treated dies up to 35%.

Structure of New/Improved Hotform after heat treating to Rockwell "C" 50. Note uniformity of structure that improves ductility.



Note coarse grain with envelope structure. Die failures due to gross cracking invariably possess this structure or worse.

New/Improved HOTFORM's fine, uniform structure is the culmination of an intensive research and development program to assure longer die life in service. Now, greatly increased resistance to pitting, impingement soldering and heat checking make New/Improved HOTFORM more than ever your first choice for first quality hot work dies. Let us detail the vital facts for you!

TENSILE PROPERTIES

0.505 ' specimens, 3 tests per condition, heat treated simultaneously

Manufacture	Size	Location of Test	Hardness Rc	Tensile Strength psi	Ductility (Red. of Area %)	% Improvement
Standard	15½" sq.	Midradius Transverse	49.6	250,000	12.9	28
Improved	15½" sq.	Midradius Transverse	49.6	256,000	16.5	
Standard	8" sq.	Center Transverse	50.3	255,000	10.7	38
Improved	8" sq.	Center Transverse	51.4	265,000	14.8	

IMPACT PROPERTIES

Charpy V-notch specimens; 6 tests per condition; heat treated simultaneously

Manufacture	Size	Location of Test	Hardness Rc	Average Impact Strength ft.-lbs.	Statistical Scatter	% Improvement
Standard	15½" sq.	Midradius Transverse	51.6	10.8	±2.9	20
Improved	15½" sq.	Midradius Transverse	51.6	13.0	±1.8	

VANADIUM-ALLOYS STEEL COMPANY

LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co.

SUBSIDIARIES: Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)

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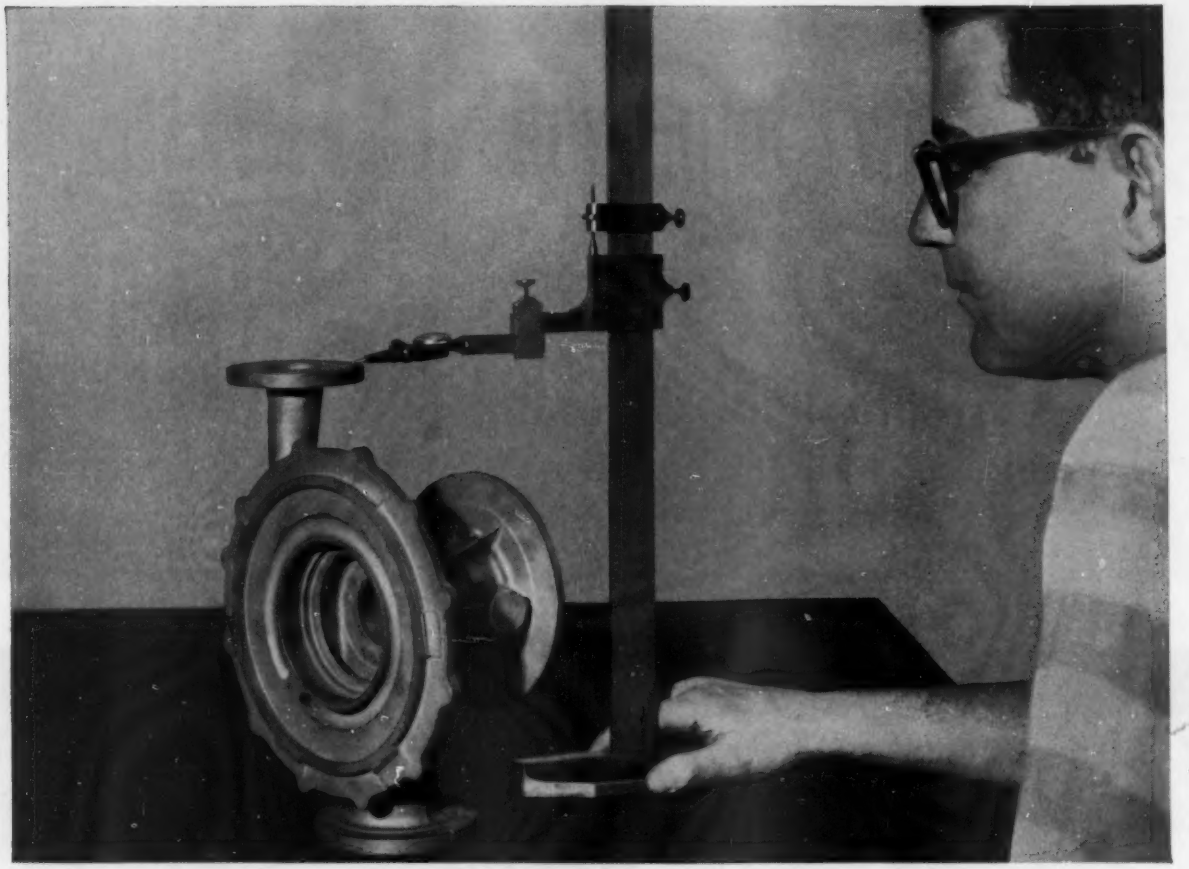

Arwood adds a new dimension to investment casting—

SIZE

Until now, an investment casting has been something you could hold easily in one hand. Today, thanks to a series of technological breakthroughs, Arwood can offer you investment castings so large and heavy that you need two hands even to budge them from the floor!

The new weight limit approaches 100 pounds.

What does this mean to you? It opens a whole new realm of possibilities in the design of component parts. For the first time, a designer can avail himself of investment casting's special advantages over a complete size range that runs from a fraction of an ounce up to weights heretofore available only in sand castings. Advantages like investment casting's ability to reproduce complex, hard-to-machine shapes in any castable metal or alloy . . . its low initial tooling expense . . . the dimensional accuracy and smooth surface finish characteristic of investment cast parts.

So . . . for quality investment castings in any ferrous or non-ferrous alloy . . . and in any size and weight . . . check with Arwood. We can free your hands to design for function and end use, because we can give you the *shape* you need in the *metal* you need in the quantity you need, no matter how *large* the part on your board. All five Arwood plants stand ready to serve you.

Write for your free copy of our 44-page "Practical Guide to Investment Casting."

Machine the simple . . . cast the complex

A complete service from design through tooling, production and finish machining. Seventy-one engineering representatives from coast to coast.

arwood

ARWOOD CORPORATION • 323 West 44th Street, New York 36, New York

PLANTS IN BROOKLYN, N. Y.; TILTON, N. H.; GROTON, CONN.; LOS ANGELES AND LA VERNE, CALIF.

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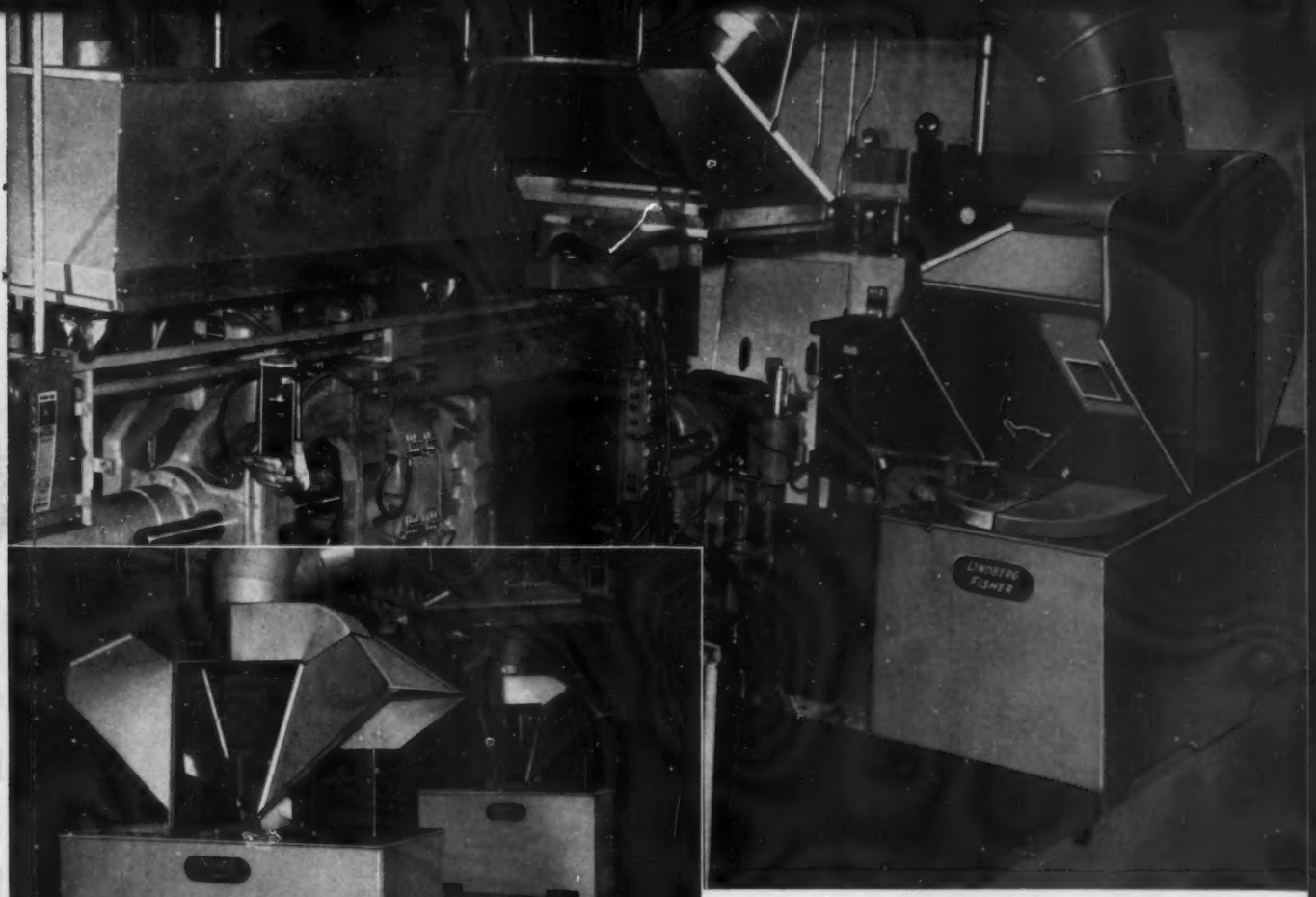


Lindberg Melting and Holding Furnaces at Electrolux Corporation, Old Greenwich, Conn., are conveniently spotted adjacent to die casting machines. Special furnace hoods remove accumulated gases.

Lindberg battery at Electrolux. These 80 KW two-chamber induction furnaces melt and hold aluminum for die casting Electrolux Vacuum Cleaner parts. Note convenient chute to return gates and risers to melting chamber with splash shield.

LINDBERG MELT AND HOLD FURNACES HELP DIE CASTING EFFICIENCY AT ELECTROLUX

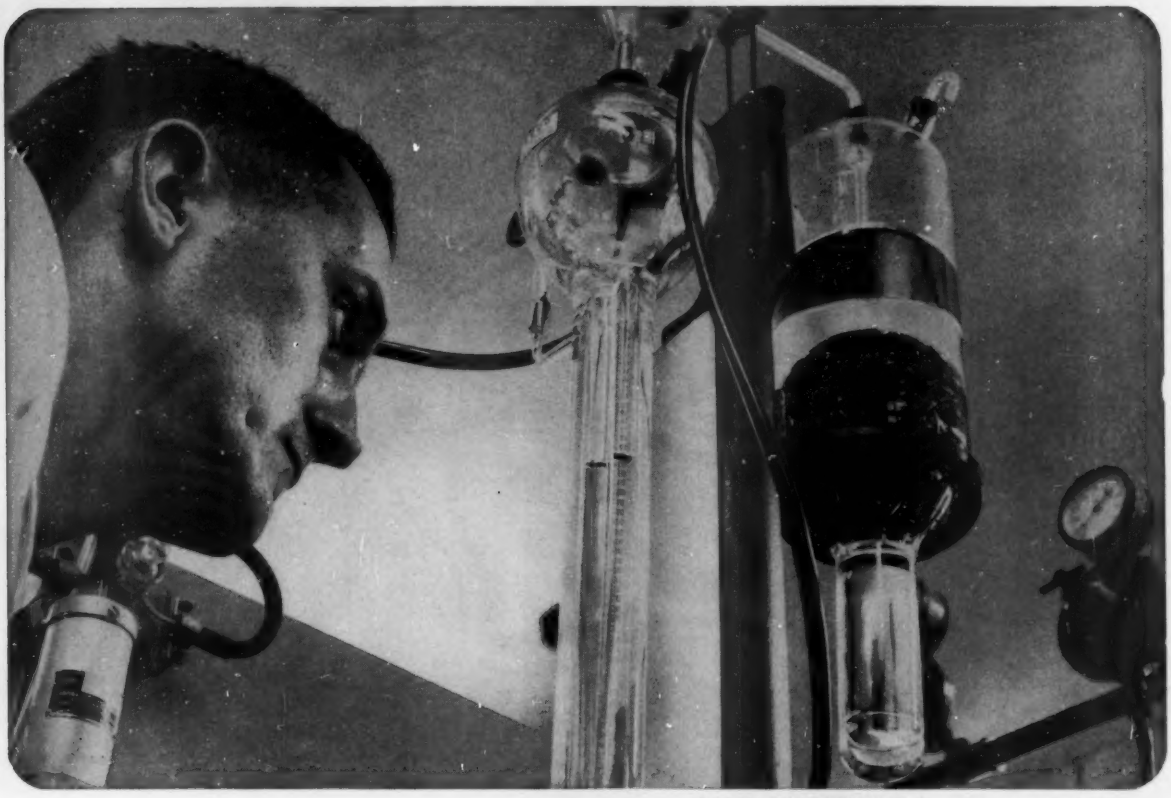
Recently, Electrolux Corporation, Old Greenwich, Conn., decided to die cast parts for the famous Electrolux Vacuum Cleaner in their own plant. To insure greatest efficiency and to provide the most ideal layout and working conditions Lindberg Two-Chamber Induction Melting and Holding Furnaces were selected to supply aluminum for the die casting machines. Electrolux has found Lindberg equipment to be completely reliable, ideal casting temperatures are easily maintained and the absence of noise and burner heat assures comfortable clean working areas. Operation has proved so satisfactory that two additional Lindberg furnaces have been purchased and are now being installed.

Wherever or however aluminum needs heat there is Lindberg equipment to apply it most economically and efficiently. Furnaces for melting and holding, casting stations, remelting or heat treating are available in all capacities, electric or fuel fired. See your Lindberg Field Representative (consult your classified phone directory) or write us direct. Lindberg-Fisher Division, Lindberg Engineering Company, 2463 West Hubbard Street, Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., Downey, Calif. In Canada: Birlefco-Lindberg, Ltd., Toronto. *Also factories in:* Argentina, Australia, England, France, Germany, Italy, Japan, Scotland, South Africa, Spain and Switzerland.

Circle No. 92 on Reader Service Card

LINDBERG heat for industry

***Experience**—the added alloy in **Allegheny Ludlum** tool steels*



QUICK, FAST TESTING for carbon content is done not once or twice but 8 times per melt in A-L's Chem Lab with this direct reading Leco carbon determinator.

Carbon content checked 8 times during melt to guarantee A-L tool steel hardenability

Lab tests for carbon eliminate your guesswork; provide high hardness, uniform hardenability, reproducible tool performance.

Because carbon has the greatest influence on hardenability, Allegheny Ludlum watches it carefully during the melt. Testing a specimen for carbon takes only a few minutes. Therefore, A-L checks for carbon content 8 times during the melt, and makes the necessary adjustments to insure accurate control of carbon. This control means Allegheny Ludlum can hold carbon content to a closer range than most customers specify.

Carbon control at Allegheny Ludlum assures you of precise response to heat treating. This control in the melt brings you predictable, *high hardness, uniform hardenability* and *reproducible tool performance.*

This is just one of the many things A-L does to insure high quality. Here are some others: close control over forging techniques, rigid temperature-time programming, careful testing of billets prior to processing to insure good surface and sound interior, control over annealing to give you the right hardness for your exact machining operation, thorough metallurgical testing to insure top tool steel quality and meeting of your specifications.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh 22, Pa. Address Dept. PM-6

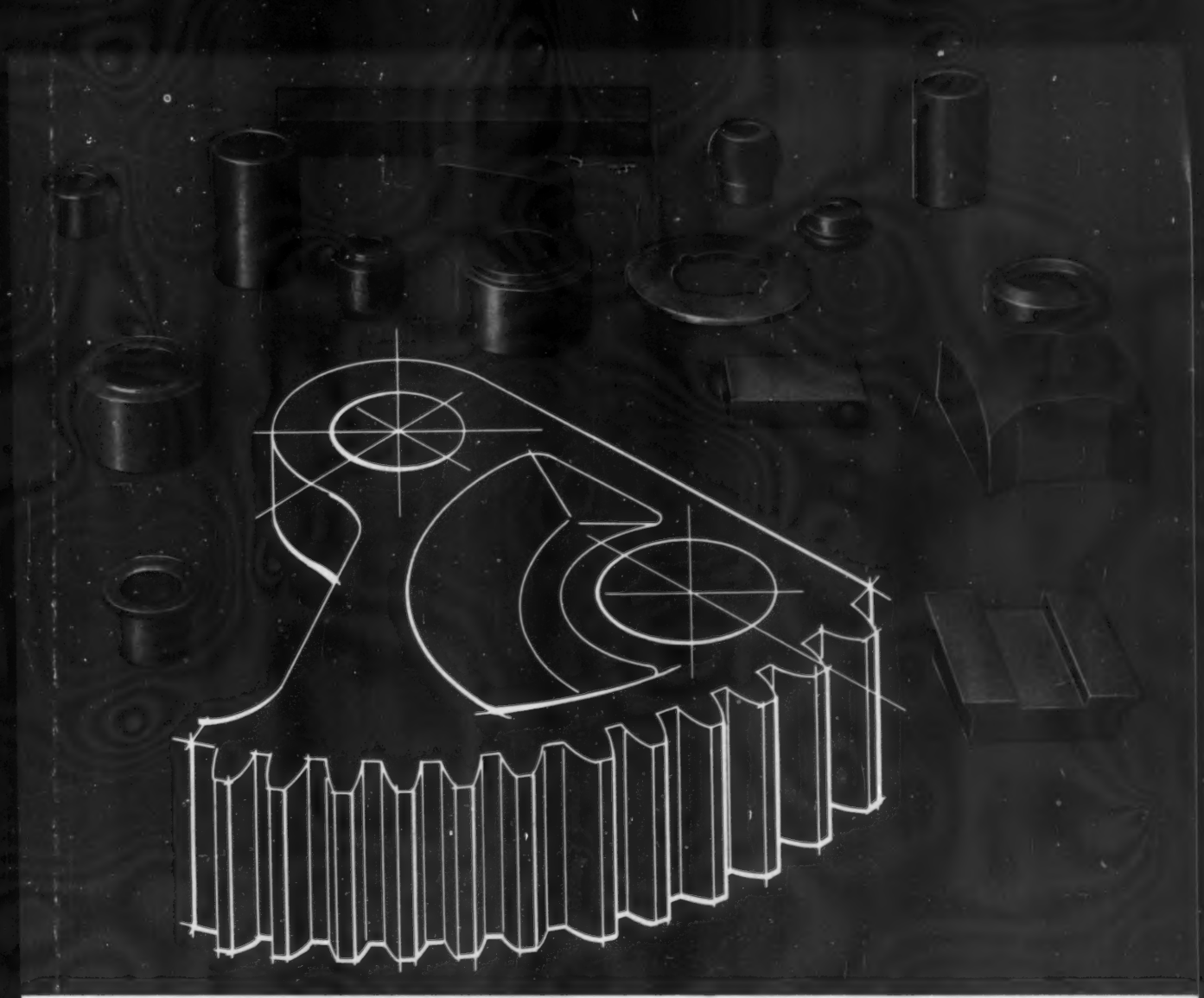
WSW-7261

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country... Check the yellow pages

every grade of tool steel... every help in using it

Circle No. 4 on Reader Service Card



WHY NOT DESIGN THIS PART FOR POWDER METALLURGY, TOO?

Forget the folklore that metal powder parts must be restricted to simple design and light loads!

Powder metallurgy has its limitations, of course, but its capabilities are far broader than any other single production technique. Just look at some of its advantages: You can obtain mechanical properties impossible with other techniques / many parts of complex design can be produced as integrated units while other methods might mean assembly of sub-parts / tolerances are close, surfaces smooth / and unit-cost-to-you is reduced because production is rapid, automatic, single-operation.

Discuss your next "problem" part with a metal-powder compacts fabricator. He knows how to help you simplify design and cut costs. And he really knows his business if he specifies AMCO Non-Ferrous Metal Powders.

AMCO DIVISION *American Metal Climax, Inc.*

1270 Avenue of the Americas, New York 20, New York

Circle No. 6 on Reader Service Card

NEW PRODUCTS AND DEVELOPMENTS

Qualified readers can get complete details on these products. Use the Reader Service Cards. You'll find them facing page 90 of this issue

INDEX TABLE HANDLES FOUR DIFFERENT JOBS

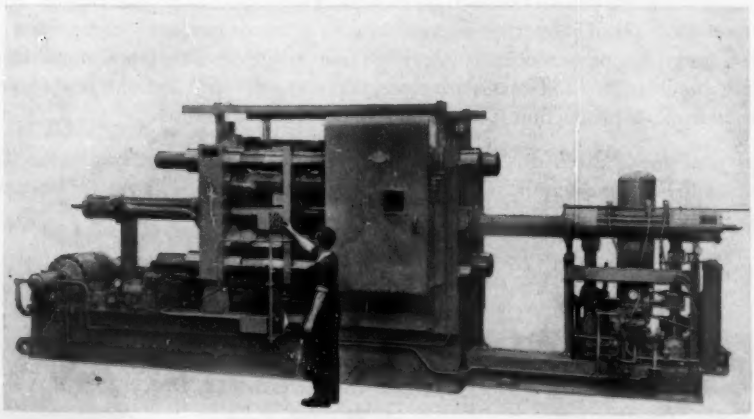
HYDRAULIC PRESS MFG. CO.—An index table for the H-P-M C-press has four separate dials, each equipped with die blocks and tooling for a different job. Simple adjustments allow changing rapidly from one job to the next. An air valve automatically ejects each part after it has passed the ram station. Another valve directs an air blast through the bottom of the table and lifts heavier parts before the side air stream blows them into an adjacent chute. Adjustable cams actuate both valves with the down stroke of each ram cycle. The index table and C-press are hydraulically interlocked through the control system of the press.

Circle No. 235 on Reader Service Card

FINISHING MACHINE COMBINES VIBRATION WITH ROTATION

MINNESOTA MINING AND MANUFACTURING CO.—The Vibraslide 5 and Vibraslide 10 barrel finishing machines speed the finishing of parts by combining vibration with rotation. This permits the mass finishing of parts not previously adaptable to barrel finishing because of shape, material or size. Gentle vibratory action rapidly produces fine finishes on the most delicate parts. Even without rotation the chip load travels faster than normal barrel rotational speeds. The units can also be used as regular rotating barrels. Demonstration and process development service is available through Honite distributors.

Circle No. 236 on Reader Service Card



DIE CASTING MACHINE

B & T DIE CASTING MACHINERY DIV., GREENLEE BROS. & CO. A high-pressure injection, cold-chamber, 1000-ton die casting machine checks out at 1200 tons on the strain gauge test. Exclusive four-corner linkage provides full support for the die and results in good platen stability. Hydraulic and electrical safety features are included. The machine weighs 43 tons.

Circle No. 237 on Reader Service Card

continued on page 58

You get speedier service from the

ZINC ZONE

Central location of American Zinc plants assures prompt deliveries of slab zinc to any point in the nation.

HILLSBORO, ILL., PLANT
Prime Western, Brass Special, Intermediate, High Grade, Continuous Galvanizing Grades
MONSANTO, ILL., ELECTROLYTIC PLANT
Special High Grade, High Grade, Continuous Galvanizing Grades, Special Shapes
FORT SMITH, ARK., SMELTER
Prime Western, Brass Special
DUMAS, TEXAS, SMELTER
Prime Western, Brass Special, Continuous Galvanizing Grades

PRODUCERS OF

ALL GRADES OF SLAB ZINC
ZINC ANODES (Plating & Galvanic)
METALLIC CADMIUM
SULPHURIC ACID
LEAD-FREE and LEADED ZINC OXIDES
ZINC CARBONATE
GERMANIUM DIOXIDE
AGRICULTURAL LIMESTONE
CRUSHED STONE

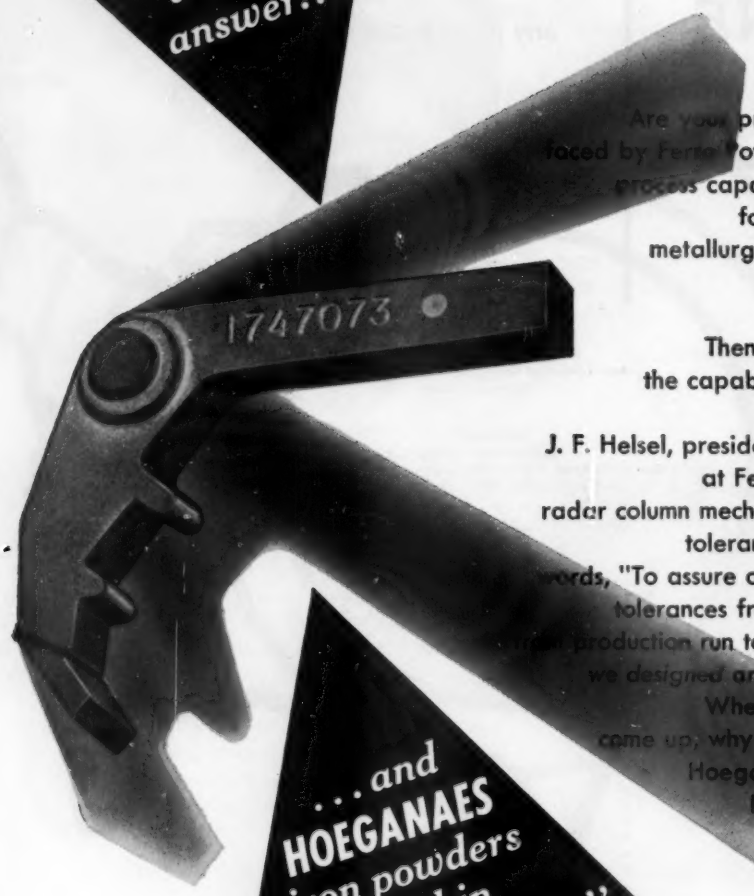
American Zinc Sales Company

Distributors for AMERICAN ZINC, LEAD & SMELTING COMPANY

Columbus, Ohio • Chicago • St. Louis • New York • Detroit • Pittsburgh

Circle No. 8 on Reader Service Card

Powder Metallurgy, rather than a casting, was the answer...



Are your problems like this specific one faced by Ferro Powdered Metals, Inc.? Where process capability studies revealed that, for this part, *only* the powder metallurgy process was economical—with resultant "blue print tolerances."

Then, you too, should investigate the capabilities of powder metallurgy and Hoeganaes Powders.

J. F. Helsel, president, and his production team at Ferro, had to be sure that this radar column mechanism would meet blue print tolerances. To put it in Mr. Helsel's words, "To assure our ability to meet blue print tolerances from lot to lot of powder and from production run to production run of the part, we designed around *Hoeganaes Ancor 80.*"

When parts production problems come up, why not call in the problem-wise Hoeganaes Engineering Specialist. He's a good man to have on your production team.

...and HOEGANAES iron powders aided in "blue print results"

This part has been successfully produced in quantity... and is supplied to one of the Nation's leading manufacturers. It's a critical part in a radar column mechanism. Produced by Ferro Powdered Metals, Inc., Salem, Indiana.

H S I C

HOEGANAES

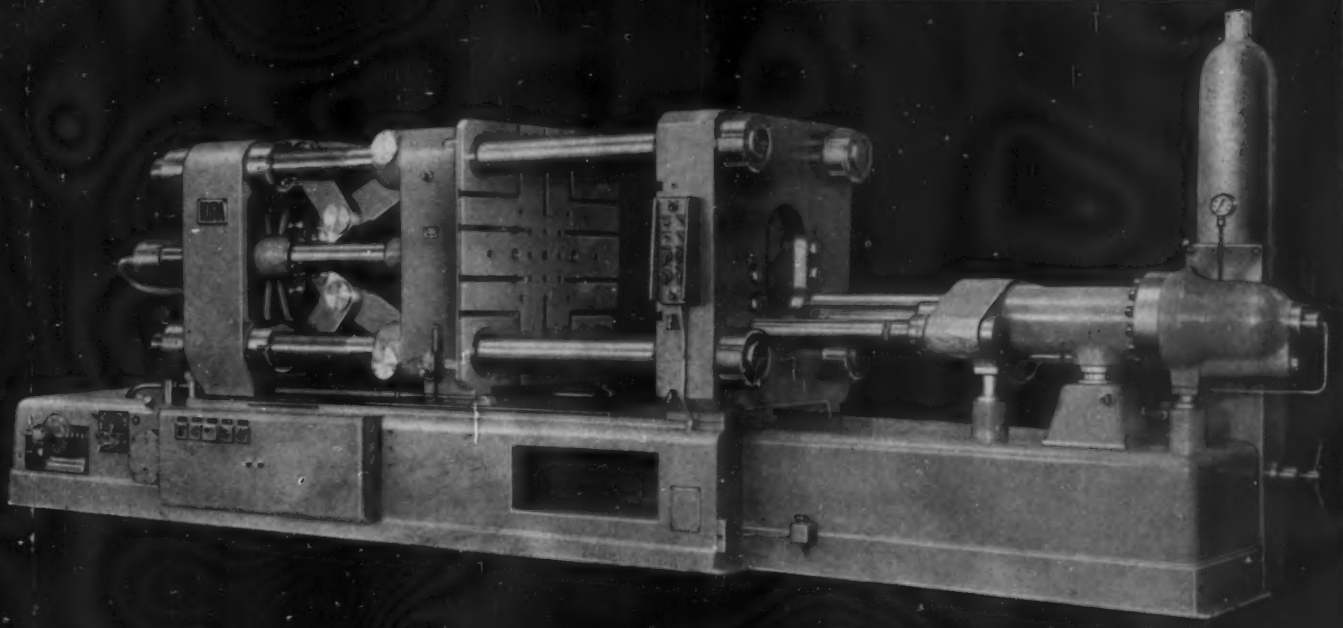
HOEGANAES SPONGE IRON CORPORATION

RIVERTON, NEW JERSEY

SALES REPRESENTATIVES IN PRINCIPAL CITIES: Birmingham, Chicago, Cincinnati, Cleveland (Fosteria), Edmonton (Alberta, Canada), Montreal (Canada), Toronto (Canada), Los Angeles, Mexico 16, D. F. (Mexico), Minneapolis, New England (Elmira, N. Y.), Odessa (Texas), Philadelphia (Riverton, N. J.), Pittsburgh, San Francisco, St. Louis

Circle No. 30 on Reader Service Card

DIE CASTING MACHINES



MODEL **OL 800** DIE CASTING MACHINE WITH HORIZONTAL COLD CHAMBER (880 TONS LOCKING PRESSURE)

IDRA

COSTRUZIONI IDROMECCANICHE BRESCIANE

pubblicità IDRA n. 712/60

SPECIFICATIONS:

LOCKING PRESSURE	880 tons
INJECTION PRESSURE	82,5 tons
DIMENSIONS OF PLATENS	51" x 51"
SPACE BETWEEN TIE BARS	31 1/2" x 31 1/2"
MOVABLE PLATEN STROKE	20 11/16"
MAX. HEIGHT OF DIES	39 3/8"
MIN. HEIGHT OF DIES	15 3/4"
FREE CYCLE PER MIN.	4 n.
MAX. WEIGHT OF ALUMINIUM PER SHOT	30.86 lbs.

WE MANUFACTURE: Die Casting Machines with horizontal cold chamber, with vertical cold chamber, with hot chamber (for Zinc alloys). Water hydraulic Die Casting Machines.

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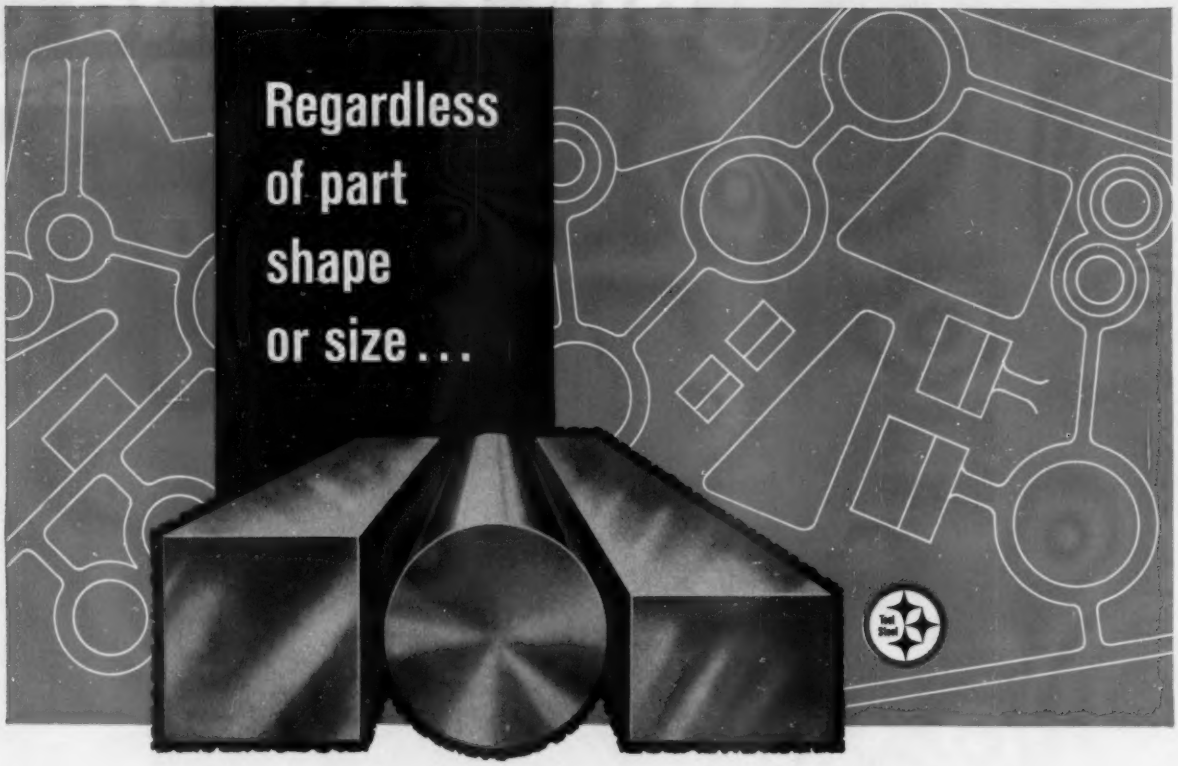

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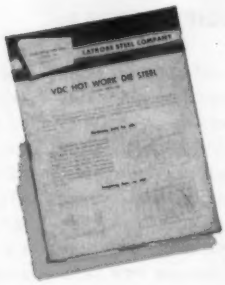

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Part shape or size presents no problem when you use Latrobe's VDC (Type H-13) hot work die steel. Easy to machine, VDC possesses excellent non-deforming characteristics and can be uniformly hardened to give ultimate resistance to wash and erosion when in service. In addition, the high vanadium content in VDC makes it ideal for magnesium or aluminum alloy die casting service in temperature ranges up to 1200 °F.

Other advantages of VDC include sound internal structures guaranteed by Reflectoscope inspection . . . freedom from porosity . . . superior impact strength . . . and a wide range of stock sizes located at nearby Latrobe Steel Service Centers for immediate delivery.

Call your Latrobe representative . . . specify VDC for *your* next die casting die.

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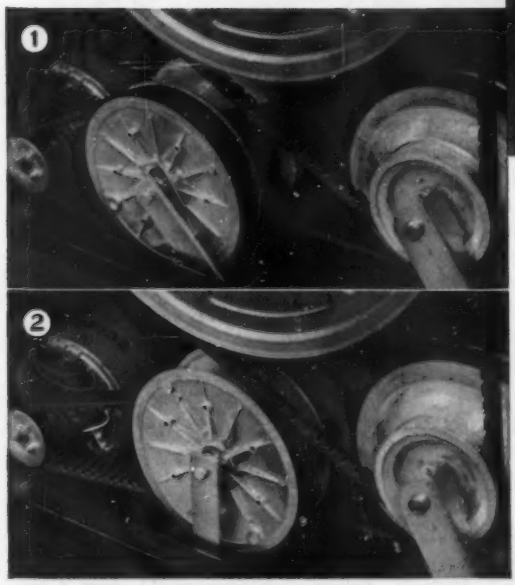
WITH HIGH STRENGTH THIN-WALL SECTIONS

WHEN DIE CAST WITH ZAMAK



A single zinc die casting—a conical disk 7½" in diameter—used in four different positions, makes up this speed changer mechanism for the General Electric Combination Washer-Dryer.

Cast with hub and radial reinforcing ribs and a projection-recess interlocking system (see view above, with one disk cut away to show cross section) two of these parts are pressed, back to back, on a bronze bearing to form a movable drive ratio adjustment. Two single pieces, locked on the ends of the tube, complete the dual-pulley assembly.

In position 1 (at left), the mechanism provides a regulated low speed for washing, rinsing and drying cycles. Moved upright, as in position 2, the drive is changed from an 8 to 1 ratio for centrifuging speeds during the water-extracting cycle.

Zinc die castings, because of their high strength in thin-wall sections, their dimensional accuracy, smooth surface and low cost, are the logical and obvious answer to the problem of producing these heavy-duty appliance parts.

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

THE NEW JERSEY ZINC COMPANY

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

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NEWS OF INDUSTRY & ASSOCIATIONS

activities of people, companies & groups in the precision metal molding industries

CONSOLIDATED BUYS ZINC DIE CASTING PLANT

One of the die casting machines in the new Consolidated plant.

Complete zinc die casting and plating facilities in Canada have been bought by The Consolidated Mining and Smelting Company of Canada, Ltd. The two plants, located on the same site in Dresden, Ontario, include National Hardware Specialties Ltd. and The Luster Corp.

Custom die castings for Canada's growing list of industrial users will be produced at the Dresden plant. They will also manufacture a line of bathroom fixtures and builders' hardware made of chromium plated zinc die castings.

President of the newly-acquired facilities is A. O. Wolff, with J. F. Buckingham as general manager. Mr. Wolff is also director of research and development for Consolidated Mining and Smelting.

Besides the large scale production of die castings, the facilities will be used for research and development activities, particularly in connection with Consolidated's work on improved electroplated coatings on zinc die castings. Anodizing and coloring of zinc castings will also be investigated here.

New machines have already been installed to enlarge the productive capacity. The first installation of duplex nickel plating equipment in Canada is in operation.

PMPMA JOINS MPIF

In a joint statement issued during the annual meeting of the Metal Powder Industries Federation, George A. Roberts, president of MPIF and Carl Demrick, president of the Powder Metallurgy Parts Manufacturers Association, announced the affiliation of the two organizations. Under terms of the merger of the two trade associations the PMPMA becomes one of the autonomous units of MPIF. It will operate as an integrated association of the contract parts producers under the broad framework of the Metal Powder Industries Federation board of governors.

With the merger of the two associations, MPIF represents the majority of the contract producers of powdered metal parts; about 35 companies (including 8 associate members).

ROBERTS DEMRICK

$1,000 ZINC DIE CASTING AWARD SPONSORED BY N. J. ZINC COMPANY

In recognition of the important contributions made by the die casting engineer to the present stature of the die casting industry, The New Jersey Zinc Company is sponsoring a $1,000 cash award to be known as "The New Jersey Zinc Company Zinc Die Casting of the Year Award."

All producers of zinc die castings are invited to enter this competition and the award will be made to the person who, in the opinion of his employer, and as reported with the entry, contributed most to the successful design and production of the part. The presentation of the $1,000 award will be made at the annual dinner of the American Die Casting Institute at the Edgewater Beach Hotel in Chicago, September 14, where the successful entrant will be the guest of the sponsor.

There is no limit to the number of entries that can be submitted by die casting producers, provided the castings were made after May 1, 1959. All entries must be received by The New Jersey Zinc Company or postmarked not later than midnight, July 31, 1960.

Judges are Dr. Allen G. Gray, Editor of Metal Progress, J. H. Schaum, Editor of Modern Castings, and Norman E. Kewley of General Electric Company.

Further information about the contest and entry forms can be obtained from the Market Development Division, The New Jersey Zinc Company, 160 Front Street, New York 38, New York.

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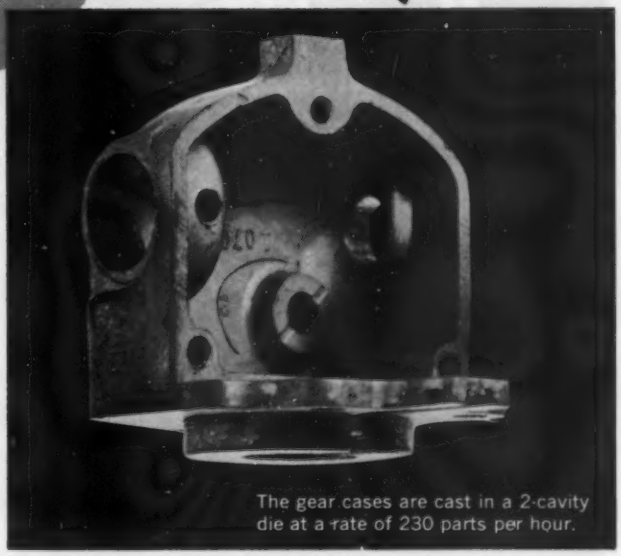
The WHOLE Story

Of Economy In ZINC DIE CASTING

Zinc die casting continues to prove one of the most efficient and economical processes to make intricate parts involving critical tolerance requirements. The gear case for a high-quality 16" oscillating fan made by Emerson Electric Co. is a good example.



The gear cases are cast in a 2-cavity die at a rate of 230 parts per hour.

THE PROBLEM WAS CASTING THE HOLES

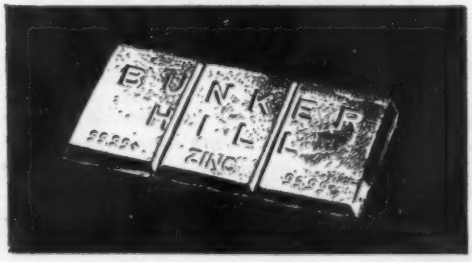
Tight dimensional tolerances are essential to this component because optimum drive efficiency demands precise alignment of motor shaft, worm shaft and oscillating drive shaft. To meet this requirement, the manufacturer specified that the shaft holes must be held to ±.0005 inch.

St. Louis Die Casting Corp. meets these extremely close tolerances despite the requirement that cores be pulled in three directions at right angles to one another. What's more, the production steps are simply "cast and trim." Since secondary machining operations are eliminated, the lower overall cost of zinc die castings precluded the use of competitive material.

DIE CASTING, is the Process...

ZINC, the Metal...

BUNKER HILL
The Preferred Zinc



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ZH-150

. . . and these fine finish plumbing fixtures tell you why

Quality is fashioned by craftsmanship. Take these sparkling chrome plated zinc castings. Note their modern, graceful lines and soft, smooth finish . . . made possible only by the qualities of purity and surface soundness and uniformity of the alloy; and the rigid maintenance of close tolerances by controlled production methods and equipment.

And here is something else! The serrations for the mating spline in the handles of these fine fixtures are held to close dimensional tolerances by reason of the identical same qualities that govern the economical production of these castings.

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Harry W. Harding
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Latrobe Die Casting Co.
Latrobe, Pennsylvania

Established 1918

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LETTERS

continued from page 11

casting firms who would be ready to consider the creation of a French subdivision. An association under the most advantageous conditions would be possible, followed by loyal collaboration. Investments of relative importance would be necessary.

At the end of 1960 the transfer of our Paris plant to Normandy is supposed to be completed. There, we shall have ample space to organize our die casting plant on an important scale and under the best possible conditions.

We would like to point out also, that die making in France for U.S. orders could be highly profitable. Salaries in this special work are considerably lower here than in the United States.

We will be glad to furnish all necessary information to any one interested.—P.S. gen. mgr.

We don't know, of course, of any companies who might be interested in establishing a die casting subsidiary in France. However, PMM will be glad to forward the name and address of this company to anyone interested.—Ed.

DIE CASTING DIE RENTAL

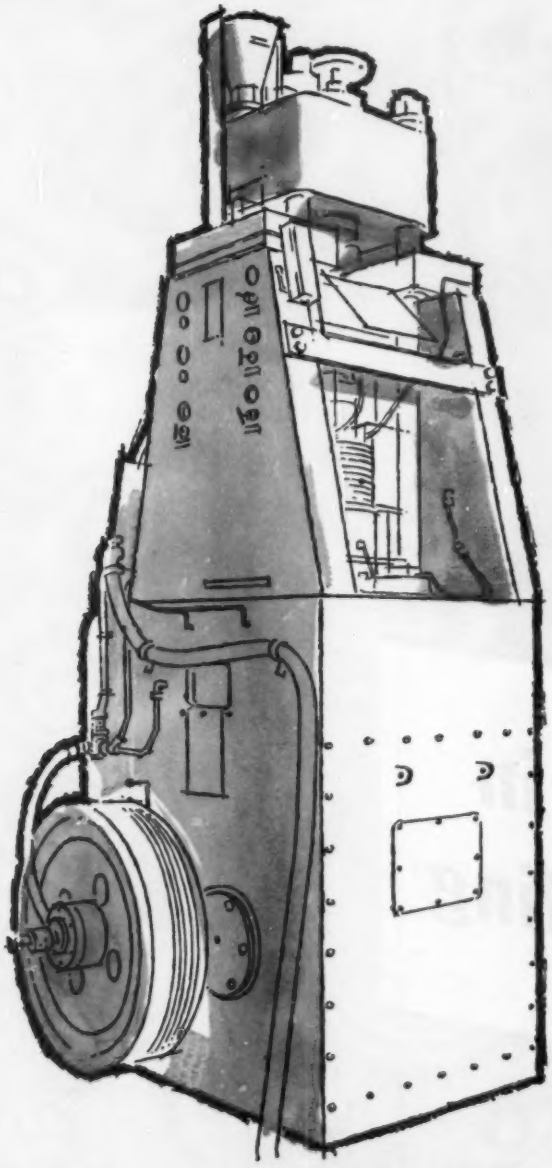
In looking back through issues of PMM, I note an answer to a request for die casting die rental or a source of used dies.

I am interested in locating a source of either used die casting dies which we could purchase, or a rental source of die casting dies. We are interested primarily in toys, hardware items, and novelties. Toys especially, miniature cars, airplanes, cowboy guns, and the like.

Will you please advise of any such sources of dies.—A.O.R., Colombia.

Anyone who has useable dies for the type items mentioned and wants to either sell them or rent them to this reader in South America can contact the writer through PMM.—Ed.

BIG PARTS, HIGH DENSITY, CLOSE TOLERANCES —all at high production with NEW BALDWIN POWDER METAL PRESSES



New Baldwin Model 200-A powder metal press features enclosed lubrication system and piping. Removable panel at base permits easy access to drive gears and bearings.

Producing high-tonnage compacting presses is not at all unusual at B-L-H. We build a complete line of mechanical and hydraulic powder metal presses up to 1000-ton capacity.

Proved design and engineering, along with years of manufacturing experience, has made the Baldwin name a standard in the powder metal industry. Die design assistance is also included in our services.

For instance, the popular 200 ton (illustrated) embodies many exclusive Baldwin features:

- Floating die for precision controlled double action
- Four-point guiding for long tool life
- Floating core rod for production of complex shapes
- Enclosed mechanism protects bearings and gears to reduce maintenance cost.

Expanded engineering and manufacturing facilities at our Industrial Equipment Division insure even greater service to our customers. For further information, write Dept. CP.

This Model 200-A powder metal press at Burgess-Norton Co., Geneva, Ill., has been producing big compacted parts at highest production rates for over 7 months.

BALDWIN · LIMA · HAMILTON

Industrial Equipment Division · Philadelphia 42, Pa.

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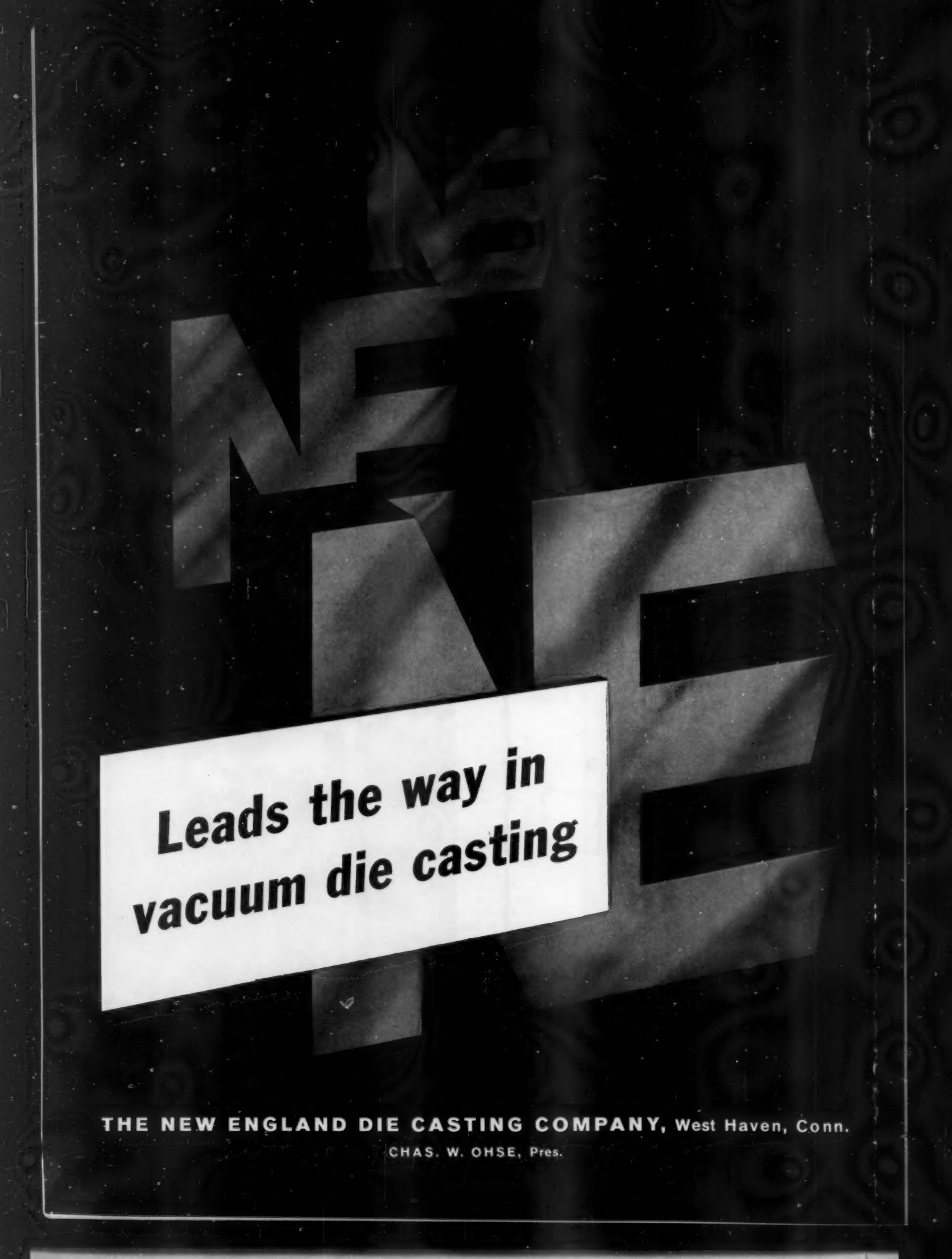


THE NEW ENGLAND DIE CASTING COMPANY, West Haven, Conn.

CHAS. W. OHSE, Pres.

Gas fluidization provides . . .

AN IMPROVED PATTERN INVESTING METHOD

By F. C. QUIGLEY AND EUGENE DELUCA *Metallurgist and Chemical Engineer, Watertown Arsenal.*

PARTICLE COATING of investment casting patterns is done most successfully in a fluidized bed of refractory material. The system can be used for both conventional investment casting molds and for making monolithic shell molds.

The conventional method of investing a pattern is to pour finely divided, refractory particles onto a pre-wetted pattern. This method is slow, requires a lot of hand manipulation and does not always give a uniform coating.

By agitating a bed of this finely divided refractory material with high pressure gas, the rather solid bed behaves like a liquid. The wax or plastic pattern can then be dipped into this bed as though it were a slurry. Because the fluidized bed behaves like a liquid, every surface of the pre-wetted pattern is thoroughly coated with refractory particles.

The equipment needed for this method of coating is simple. At the Watertown Arsenal, a rectangular box with two compartments is used. The compartments are separated by a diffuser plate. This plate gives uniform gas distribution in the upper chamber.

The lower chamber is simply a high pressure gas reservoir. The upper chamber contains the refractory particles. The dimensions of the equipment can be varied to suit individual needs.

Using aluminum oxide particles of 0.0138" and 0.0062" or silicon dioxide particles of 0.0117" average diameter, a fluid bed can be maintained with air at 90 psi. As the bed height and porosity are varied to meet investing conditions, the particle size and the air pressure must, of course, be varied.

A sketch of the apparatus used at the Watertown Arsenal is shown in figure 1 and the equipment in use to coat a pattern in figure 2.

The time to coat a pattern has been cut to only a few seconds with this equipment.

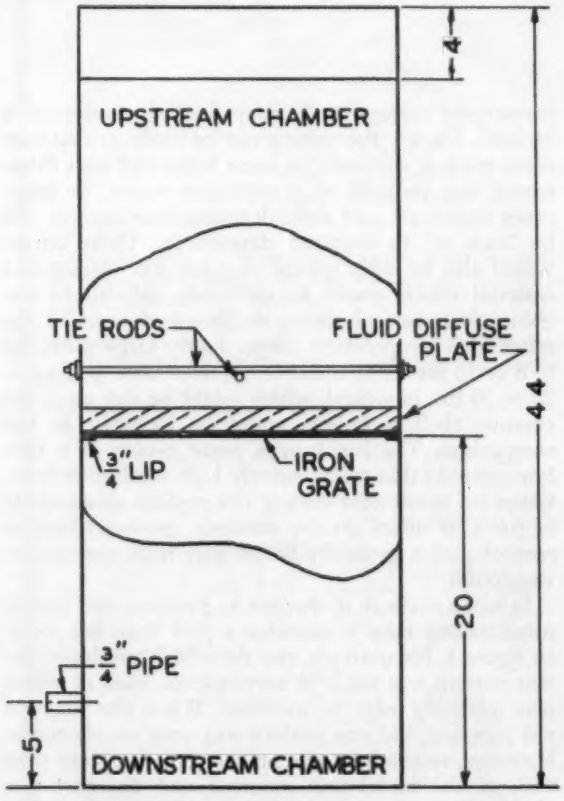


FIG. 1 APPARATUS used to fluidize a particle bed for coating investment casting patterns.

FIG. 2 COATING a pattern cluster in a fluidized bed of refractory material.

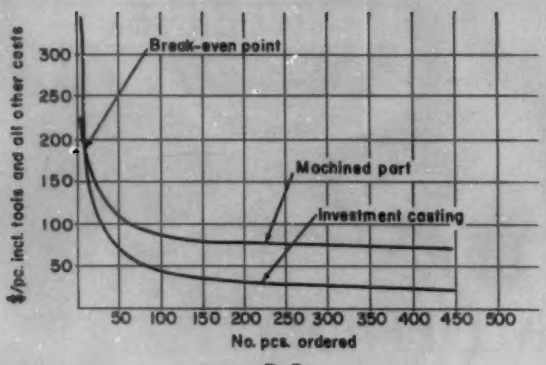


Fig.I

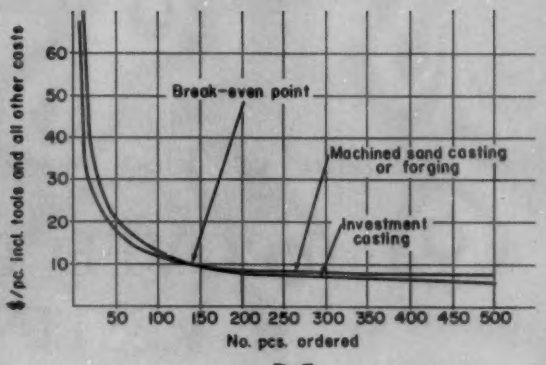


Fig. II

THE BREAK EVEN POINT IN INVESTMENT CASTINGS

By WILLIAM C. MILLER *Dist. Sales Mgr., The Hitchiner Mfg. Co.*

A frequent question asked of the investment casting salesmen is, "How many parts must we produce to make an investment casting economically feasible?" There is no standard answer, there is not even a rule of thumb which applies. Economy depends on the part. The only safe way to determine a "breakeven" point is to estimate the cost by one or two other ways, obtain a quotation from an investment casting company, and then plot curves similar to figures 1, 2, 3, and 4.

There are two popular misconceptions about investment castings. One is that quantities must be very large before investment castings can be considered. The other is that the quantities must be relatively small before you can consider investment castings. Obviously, both of these opinions can not be correct.

Figures 1, 2, 3, and 4 are typical comparisons. They show that the break even point can occur at almost any quantity depending on the specific part. However, the curves are fairly general in their make-up for the methods of fabrication considered. IT MUST BE UNDERSTOOD, HOWEVER, THAT FOR ANY SPECIFIC APPLICATION VALUES MAY NOT BE TAKEN FROM THESE CURVES.

Figures 2, 3, and 4 are typical comparisons. They require expensive "hogging" operations and then many intricate machine set-ups. The tolerances held are compatible with the investment casting process. Many times, the "hogging" operations can be eliminated by investment casting, and many final dimensions can be held. Usually the casting can be made so that only ream stock is necessary in some holes and wall thicknesses can be held at a minimum value. In many cases undercuts and difficult-to-machine corners can be "cast in" to required dimensions. These curves would also be fairly typical of a fair size casting in a material which would be extremely difficult to machine; such as tool steels, stellites, and some of the other high temperature alloys. Fairly large parts, up to 8 or 10 inches in a maximum dimension and up to 20 or 30 lbs. in weight, which might be cast using the ceramic shell technique could be included in this comparison. The break even point occurs at a very low quantity due to excessively high machining costs. Often, an investment casting can replace an assembly of parts. It offers greater strength, greater tolerance control, and a generally better part from appearance standpoint.

In some cases it is cheaper to produce one investment casting than to machine a part from bar stock. In figure I, for example, the die which produced the wax pattern was made in seven pieces, each of which was relatively easy to machine. When the die was put together, the wax pattern was very simply made. However, to machine the part was costly. More than 95% of the metal was removed and the part was extremely complicated and difficult to machine. To

continued on page 34

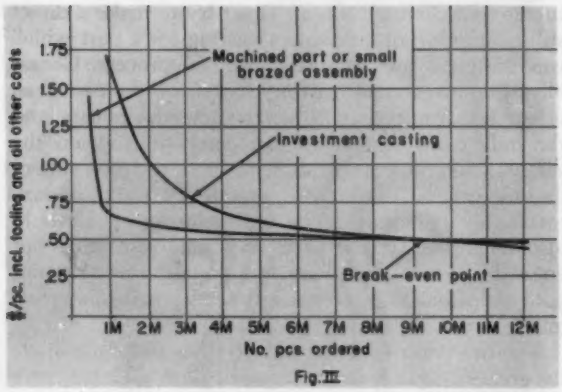


Fig. III

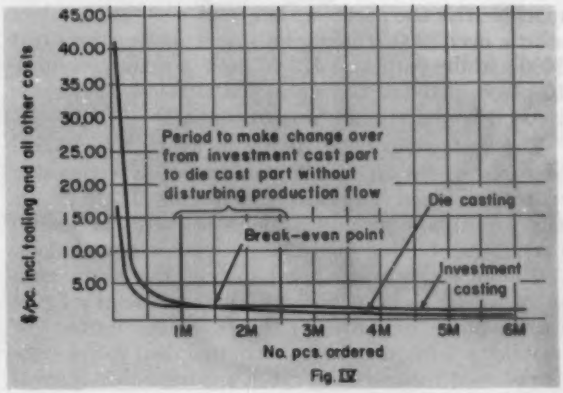


Fig. IV

BASIS OF CURVES

FIG. I

This curve might be applicable to a typical large complicated part requiring extensive machining, many machine set-ups, or a material which is extremely difficult to work. The investment casting curve includes a cost for secondary machining operations.

Machined Part:

Tooling — $350
Mach. Cost — 150/ea. (1-10 pcs.)
100/ea. (11-50 pcs.)
75/ea. (51-250 pcs.)
73/ea. (251-450 pcs.)
Mat'l cost — 3/ea.

Investment Casting:

Tooling — $1200
Part price — $50/ea. (1-10 pcs.)
35/ea. (11-50 pcs.)
25/ea. (51-100 pcs.)
22/ea. (101-500 pcs.)
Mach. Cost — $15/ea. (1-10 pcs.)
12/ea. (11-50 pcs.)
9/ea. (51-100 pcs.)
7/ea. (101-500 pcs.)

FIG. II

Curves similar to those shown above might be plotted for many fairly small sized sand castings or forgings requiring considerable machining or a number of set-ups. This set of curves might also be typical of an assembly of several parts which might require a very minimum of machining but also require fixturing for brazing, welding, etc.

Machined Part or Assembly of parts:

Patterns/Tooling — $350.00
Casting or part cost — $3.50/ea. (1-50 pcs.)
1.50/ea. (51-100 pcs.)
1.35/ea. (101-250 pcs.)
1.25/ea. (251-500 pcs.)
Machining/assembly, etc. —
6.00/ea. (1-25 pcs.)
4.50/ea. (26-100 pcs.)
4.00/ea. (101-250 pcs.)
3.80/ea. (251-500 pcs.)

Investment Casting:

Tooling — $800.00
Part cost — $6.00/ea. (1-50 pcs.)
3.50/ea. (51-100 pcs.)
2.85/ea. (101-250 pcs.)
2.75/ea. (251-500 pcs.)
2.65/ea. (501-)
Machining costs — $3.00/ea. (1-50 pcs.)
1.80/ea. (51-100 pcs.)
1.70/ea. (101-250 pcs.)
1.60/ea. (251-500 pcs.)
1.55/ea. (501-)

FIG. III

Because of more elaborate multi-cavity tooling to produce the castings most economically, the break-even point occurs at a much higher quantity level. This is typical when investment castings are competing against relatively costly screw machine parts with relatively small tooling costs. Investment castings compete only if machining of castings is almost nil.

Machined part or assembly:

Tooling/fixtures — $350.00
Machining/ass'y. & part costs —
$.65/ea. (501-1000 pcs.)
.60/ea. (1M-2.5M pcs.)
.54/ea. (2.5M-5M pcs.)
.50/ea. (5M-10M pcs.)
.47/ea. (10M-)
Mat'l & tool upkeep — $.04/ea.

Investment casting (no secondary operations of machining):

Tooling (multi-cavity) — $1200.00
Part costs — $ .60/ea. (500-1M pcs.)
.50/ea. (1M-2.5 pcs.)
.44/ea. (2.5M-5M pcs.)
.41/ea. (5M-10M pcs.)
.39/ea. (10M-)

FIG. IV

Because die casting tooling is considerably more expensive than Investment casting tooling, sometimes prototype runs can be made using the lost wax process to prove the application and function of the design. A smooth changeover can then be made if the application is successful without interruption of production flow.

Die Casting:

Tooling — $2,000.00
Part price — .60/ea. (50-250 pcs.)
38/ea. (251-500 pcs.)
.36/ea. (501-1M pcs.)
.30/ea. (1M-5M pcs.)
.24/ea. (5M-25M pcs.)

Investment Casting:

Tooling — $750.00
Part price — 2.00/ea. (50-250 pcs.)
1.50/ea. (251-500 pcs.)
1.40/ea. (501-1M pcs.)
1.34/ea. (1M-5M pcs.)
1.32/ea. (5M-10M pcs.)

machine this one part from bar stock cost the customer a little over $900. Tooling for investment castings cost $600 and the parts cost $23.00 each in quantities up to 10 pieces and this charge included 100% Xray-three views, Magnaflux, and heat treatment.

The cost comparison shown in figure 2 is typical of parts where an investment casting is competing with a machined sand casting or forging. These curves also would be typical of a simple assembly of several parts. Since tooling for forging a part is more expensive than tooling for a sand casting, the break even point would occur at a slightly higher quantity figure for the same part than is shown on the curve. For simplicity a forging curve is omitted, call it the same as the sand casting curve. It is apparent that there is less cost reduction in this set of curves than in those curves shown in figures 1 and 3 because of the inherent low cost of a sand casting or forging. In considering an investment casting versus a sand casting or forging, the amount of saving depends strictly on the intricacy of the machining necessary. The illustration in figure 2 would be typical of a part requiring relatively simple but also fairly extensive machining of a sand casting. The spread between the two curves would get progressively larger when the machining became more and more intricate. The investment casting process is able to hold much closer tolerances, obtain a much finer finish, and requires less machine work than would be necessary on a sand casting.

It is important to understand that all of the curves shown include the cost of secondary operations. They are plotted on the basis of a completed part, ready for use by the customer.

In many cases investment castings gain the customer an added advantage. A greater variety of materials can be cast using the investment process than can be obtained in forgings and sand castings; sometimes at a lower price than the customer expects. Some of the more expensive raw materials are actually more easily investment cast than some of the cheaper alloys. The customer gets a lower price because of a lower scrap rate on the better pouring alloy. For example, investment casting foundries would far prefer to cast 302 stainless steel rather than 1010 carbon steel. A part probably would cost less in 302 stainless than it would have in 1010. Naturally, it is impossible to plot this sort of thing, but it should be considered when the engineer or purchasing agent decides how to obtain the part he desires.

Figure 3 illustrates an investment casting competing with a small relatively expensive screw machine part; that is, a screw machine part requiring perhaps 2 or 3 set-ups or having difficult or tedious operations. Obviously the break even point here occurs at a much higher quantity level because the screw machine part requires little tooling but the investment casting has to go to multicavity tooling to obtain the casting at the most economical rate. This type part is much more difficult for the designer or purchasing agent to analyze. It requires the closest liaison between the investment casting producer and the engineer. It is this type of part where the greatest cost savings can sometimes be effected. Call in the precision casting company to help in the design of the part for the investment casting process. Don't try to make a direct substitution of an investment casting for a part which was designed for the screw machine process. Generally, the investment casting foundries do not even attempt to compete with screw machine houses and the only cases where we can compete is when the screw machine part is difficult and the investment casting can be made with practically no secondary machining operations. The curves in figure 3 would also be rather typical of a very small assembly but could be cast in one piece as a precision casting and gain the advantage of strength and possibly appearance.

The investment casting industry has probably made its greatest strides in the area of high quantity production. Runs of 100,000 pieces, and more, are becoming more and more common. This advance has come through the use of injection molded plastic patterns. They can be made very rapidly on multi-cavity water cooled dies and thus eliminate a great part of the labor costs inherent in making wax patterns 1, 2 or 3 at a time. The plastic patterns can now be made with as many as 20 or more cavities. They incorporate sprueing and gating arrangements on the part. This eliminates hand sprueing and gating operations so that the process becomes automated to a degree once thought impossible. This is an area which requires very close liaison between the casting source and the customer at the design level.

Figure 4 shows a curve where an investment casting is competing with an aluminum die casting. Almost the reverse is true of what was shown in figures 1, 2 and 3. Figure 4 compares investment casting with die casting. Precision castings compete only at the lower quantity level since the tooling for an investment casting is much less expensive than the tooling necessary for a die casting. There are other values to keep in mind on aluminum parts where, perhaps, even at high quantity levels a die casting is not practical. For example, die castings do not lend themselves readily to the anodizing process and where the anodizing process is called for, precision castings may be required.

In summation we urge that an engineered quotation be obtained from a reputable investment casting company and a fair comparison of costs be made considering all additional advantages which may be obtained from an investment casting. This is the only "fool-proof" way that the "break-even" point can be determined for any specific part.

Editor's Note: This article should help to get rid of some of the misconceptions about when or when not to design for and specify investment castings. Like every other manufacturing process, investment casting must be judged in the light of the part to be made.

Properly applied, investment casting is a good and an economical method of manufacture. Improperly applied it is a production headache. It is our hope that this article will help to avoid some of the misapplications.

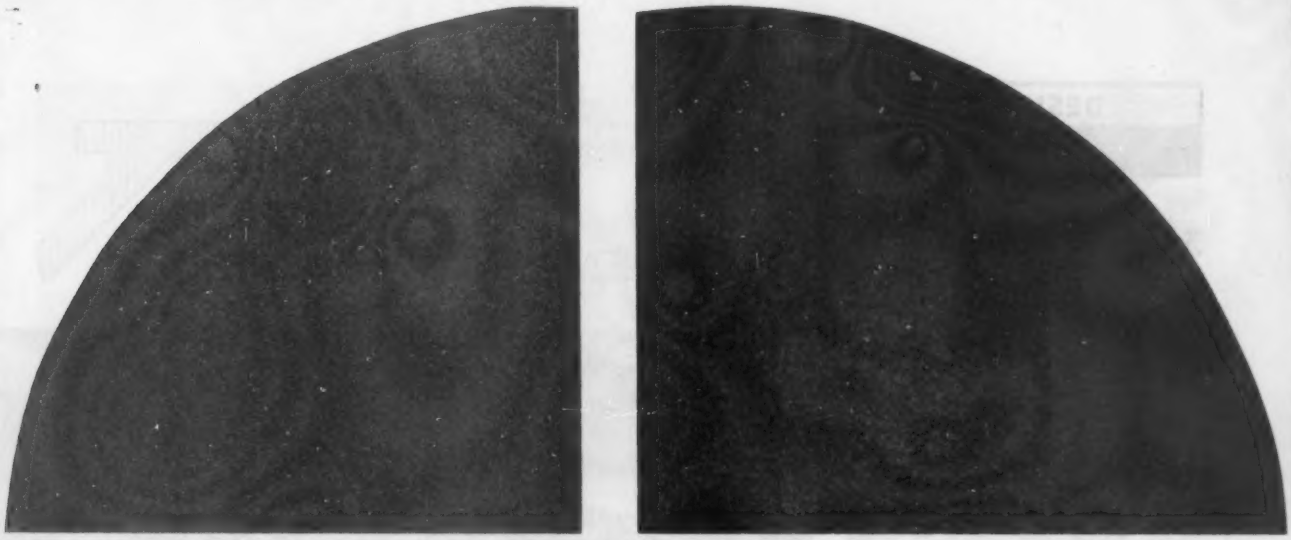


FIG. 1 MACROSECTIONS of vacuum cast (left) and air cast (right) tool steels. The fine grain size and absence of included "dirt" is clear. The cleaner steel is one reason for superior service life.

VACUUM MELTING FOR TOOL AND DIE STEELS

By KENNETH H. CARLSON, *Technical Mgr.—Specialty Steels, Latrobe Steel Co.*

VACUUM MELTING of tool and die steels has now become a standard practice. Even though the tool steels produced by vacuum melting techniques are being used almost exclusively in the aircraft industry for structural parts such as bearings, spars, and landing gear components, great interest is developing for their application to cutting tools, among others. This interest is being generated because of the superior mechanical properties and internal cleanliness evidenced by the vacuum melted product—and many tooling applications can use these improved properties to advantage even though the raw material costs are higher.

Perhaps the most commonly used vacuum melted tool steels to date are the bearing steels (52100 and its modifications, as well as the high speed steel such as M-50 for heat resistant bearings) and H-11 hot work die steels. Recent development and expansion of vacuum arc melting facilities has made available these products in larger quantities, larger section sizes and lower cost than ever before. For example, Latrobe Steel Company has installed a second vacuum arc furnace, capable of producing ingots up to 8,500 pounds and 20 inches in diameter, designed specifically for tool steel and specialty alloy steel melting.

Among the hot work die steels, H-11 has become popular with the aircraft industry for structural members which may be exposed to elevated temperatures at high speeds, or which require low internal stress level after heat treating to high strengths. Lack of uniformity in ductility properties at high strength levels has been a drawback to this and other steels, but such non-uniformity can be virtually eliminated by vacuum arc melting.

These improved properties can be attributed to (1) superior cleanliness, (2) improved ingot structure and (3) elimination of dissolved gases and other undesirable interstitial contaminants. All these improvements are obtained by proper vacuum arc melting, and represent a long step forward in the technology of fine steels. Figure 1 illustrates the improvement in uniformity of structure as shown by macroetch inspection slabs.

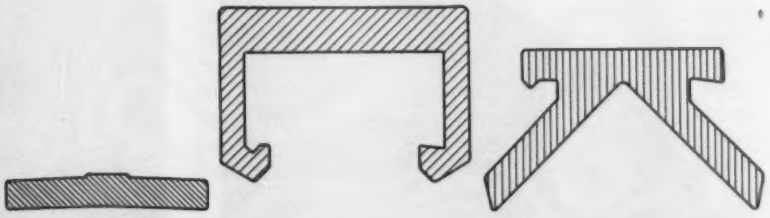
Similar improvements are obtained in vacuum arc melting of bearing steels. Because of better cleanliness, fatigue life of bearings has been reportedly improved by 50 to 100 per cent.

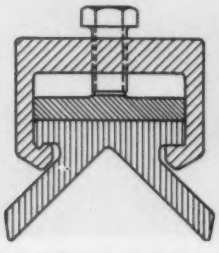
Tool and die steels have traditionally been representative of the finest quality possible to produce. The mechanical and cleanliness requirements have been very high, and the tool steel industry has made long strides toward producing an almost perfect product. With the advent of vacuum arc melting, however, even further improvements may be expected.

Evaluation programs are now underway to establish the importance of vacuum arc melted tool steels in such applications as precision rolls, plastic molds requiring extremely high polish, extrusion dies, high speed steel cutting tools, and die casting dies, to name a few. While the limiting factor in many such tooling applications is design rather than the tooling material, there are some instances in which the tool steel itself must be improved for better performance. There is a good chance that in such applications the superior surface finish obtainable, and the improved toughness resulting from the vacuum melted steel will result in significant improvement in service life of the tools and the surface finish of manufactured parts.

DESIGN FOR
EXTRUSIONS

3-Extrusions →





Combined ↑
to form . . .

A CRANE CONDUCTOR SYSTEM

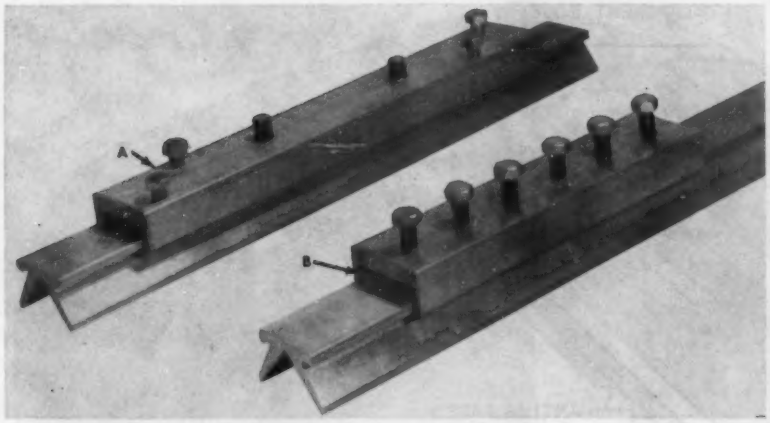
Steel bar or copper wire traveling crane conductory systems have several disadvantages: Both are complex to install and expensive. The tooling required, rolling and drawing, is considerable. Both systems require heavily reinforced mounting structures for installation. The copper wire systems lack rigidity and often bend. The steel bar systems need costly copper booster systems to maintain proper current flow.

To overcome what has been referred to in the industry as the crane conductor problem, the Electric Service Works, Delta-Star Div., of the H. K. Porter Co. developed an extruded aluminum conductor system that features high current capacity and low impedance drop. This makes the system ideal for many types of conductor rail installations. The system, which consists of 3 basic extrusions, requires less space than conventional systems and is designed to provide maximum current capacity with the least amount of material.

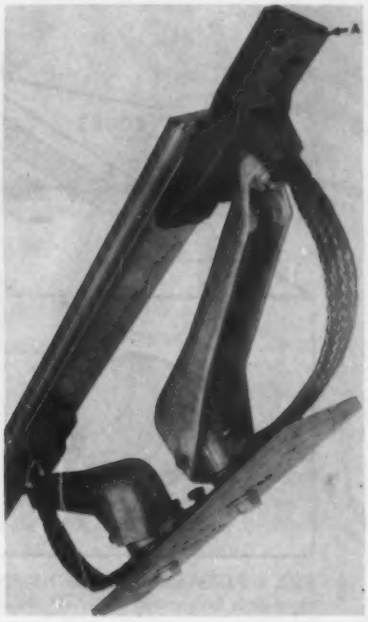
The features of the extruded aluminum system are:

1. Rigidity—The extruded conductor, is designed to be rigid. It will not bend as do wires.
2. Surface Area, Protection—The inverted V shape of the conductor not only offers a large contact area for the pick-up, it also protects the contact surface.
3. Inexpensive Tooling—The only tooling cost for the 3 extrusions is for 3 dies. They were under $300 each.
4. Electrical Characteristics—The extrusions will handle the electrical loads required. The conductors come in 4 sizes with continuous current ratings of 1,000, 2,000, 3,000 and 6,000-amperes. A 500-ampere system comes in bronze.
   Using extrusions enables the company to make the conductors small, reduce spacing between the conductors, and lower the inductance and impedance on A.C. systems. Because of its low impedance, the system has good voltage regulation for alternating current. This provides adequate voltage supply for maximum crane operating speeds and reduces motor overloads.
5. Easy to Assemble—All that's needed is a wrench.
6. Lightweight—Aluminum extrusions need no expensive, heavily reinforced mounting structures. It is considerably cheaper and faster to erect a lightweight conductor.
7. Corrosion Resistance—Aluminum resists corrosion in almost all of the atmospheres where it is installed.

The extruded conductor systems are available in 3 alloys: 6063 T6 aluminum; electrolytic tough pitch copper (only for 1,000-ampere and 2,000-ampere systems); architectural bronze, (only for 500-ampere systems). The copper and bronze extrusions are used only where special corrosion resistance is needed. They're usually found in hydroelectric works or on other outdoor installations subject to long periods of inactivity or where variable voltage control circuits are used.



THE EXTRUDED HANGER, (A above) supports the conductor. At joints, a splice plate (B above) is added to the assembly to form a rigid joint.

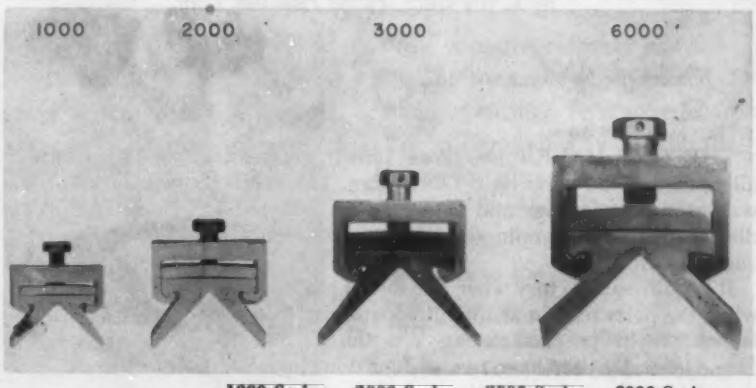


SINTERED COPPER-GRAPHITE pick-up shoes are used to insure good electrical contact and long life.

THE COLLECTOR ASSEMBLY USES SINTERINGS

The collector assembly is the electrical pickup that rides with the crane. It consists of 2 contact shoes, 2 shoe support holders, and 2 arms for each conductor rail being used. Naturally, the collector wears as it slides in the groove of the conductor. This wear has been minimized by good design of the shoe, and use of the right alloy, a non-corrosive material, that lasts longer than steel shoes. The shoe is composed of copper, graphite, and other alloys. The alloy could not be chosen haphazardly, because many materials would gall the aluminum. The collector is designed to assure long life. The collector has to adjust itself to any conductor misalignment. Also, the shoe has to be hard enough to abrade the track and keep it clean. (Note: Although the aluminum conductor has an oxide film, the shoe does not have to break this down. The voltages used are high enough to penetrate and break down the film. The shoe has to clean only the corrosive compounds that form on top of the oxide film.) To meet these requirements, the contact shoe was designed as a sintering.

Electrical & Physical Properties of the Extrusions.



	1000 Series	2000 Series	3000 Series	6000 Series
ELECTRICAL				
Current Capacity	1000 Amps	2000 Amps	3000 Amps	6000 Amps
Conductivity	55%	55%	55%	55%
Area in CM	2.31×10^6	4.14×10^6	6.2×10^6	11.1×10^6
PHYSICAL				
Material	6063 T6 Alum.	6063 T6 Alum.	6063 T6 Alum.	6063 T6 Alum.
Area in Sq. Inches	1.817	3.25	4.87	8.73
Wt. Per Foot	2.18	3.90	5.60	10.00
Tensile Strength	32000 psi	32000 psi	32000 psi	32000 psi
Yield Strength	25000 psi	25000 psi	25000 psi	25000 psi
Modulus of Elasticity (Tension)	9.9×10^6	same	same	same
Hardness (Brinell) 500 Kg. 10 MM Ball	73	73	73	73
Coefficient of Expansion (Thermal) Steel is 6.6×10^{-6}	13×10^{-6}	13×10^{-6}	13×10^{-6}	13×10^{-6}

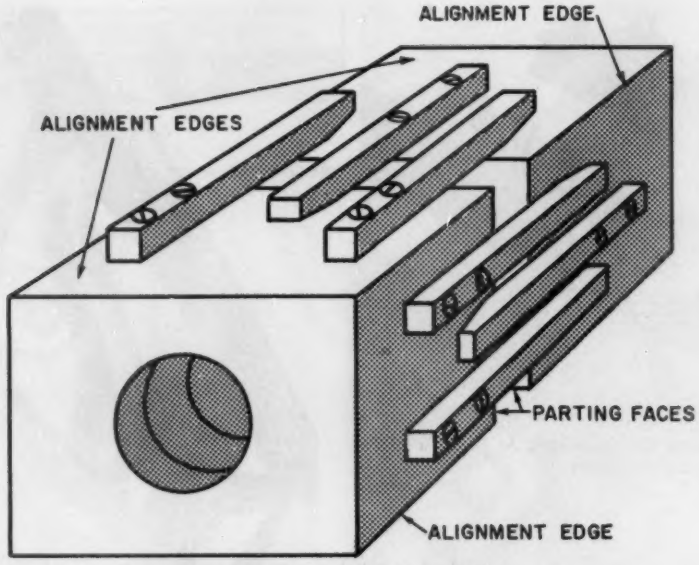


FIG. 1 PERMANENT ALIGNMENT, independent of thermal expansion is secured with external guides instead of dowels.

FIG. 2 A PERMANENT MOLD.

IMPROVING DIE ALIGNMENT

By A. TOWNHILL, *Pacific Palisades, Calif.*

THE TOOLMAKER uses dowel pins to get precise alignment of the parts he is fabricating. This method was used first for jigs and fixtures, then adapted to dies of all kinds: stamping dies, permanent mold dies and die casting dies.

It is quite satisfactory when one dowel pin is used or when the parts remain at room temperature. In a permanent mold or die casting die this is not the case. Generally they have two or four dowel pins and the parts are heated for casting.

Dies cannot be raised to temperature instantaneously nor uniformly, this creates a problem. The dowel pins and the respective holes into which they should fit do not have the same spacing as when they were cold. The die halves are pressed together and the pins score or the die halves are then difficult to take apart. The natural remedy is to provide more clearance between the dowel pin and its respective hole. After several trials a satisfactory clearance is found, but the accuracy of alignment has been destroyed. In permanent mold dies it is necessary to give the pins as much as .020 inch clearance, although they originally had .002 inch.

The desirable solution would be dowel pins which provide accurate alignment, independent of temperature changes. To do this choose two surfaces which do not change in relation to one another when heated. The cavity in the die can be located from these faces.

When the die halves are together the edges of the die provide a good working surface. If two adjacent edges are selected, we can hold these edges firm and allow the dies to expand as the temperature rises.

To get this edge alignment start in the tool shop. After the cavity is cut, the two halves of the die must be carefully aligned then clamped together. Two adjacent edges are then ground perpendicular to the parting face.

The two adjacent faces on each die half will become the locating edges, which must always be kept in perfect alignment.

The pins will no longer be round but square. As shown in figure 1 each of the two adjacent faces on each die half will have two dowel pins fastened to it and projecting over the mating surface.

Each pin is securely bolted to the edge of its die half. The four pins on each of the adjacent sides will then maintain accurate alignment of the edges regardless of temperature. Either hot or cold, these two edges will remain in perfect alignment.

It is true that the cavity will change its distance from the locating edge as the die is heated, but as the temperature becomes uniform the distances will again become equal and the cavities will match. If for some reason the die halves do not have a resultant expansion which is the same, a sample casting poured after the dies are thoroughly heated will provide sufficient in-

continued on page 92

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FIG. 1 SAVED—62% in cost and 33.5% in weight by using die castings.

REDESIGN TO STAY COMPETITIVE

By ARTHUR W. RICHART, *Chief Engineer, Leslie Co.*

DOES REDESIGN really pay off? If you ask our management you'll get an emphatic yes. Why? Some of our control instruments were being priced out of the market. We redesigned, got a better operating, better looking instrument that's competitive. Our Pressure Pilot Control (Figure 1) is a good example.

This unit operates on a maximum air pressure of 25 psi, but has to stand a test pressure of 60 psi. It has to be mechanically strong and able to resist corrosive industrial atmospheres. Aluminum sand castings have always done a good job. We knew that we could make five of the sand cast parts by die casting.

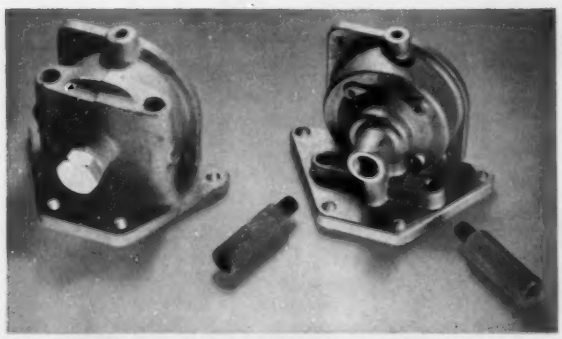


FIG. 3 WEIGHT, cost, and corrosion were all licked by making this valve body as aluminum die castings.

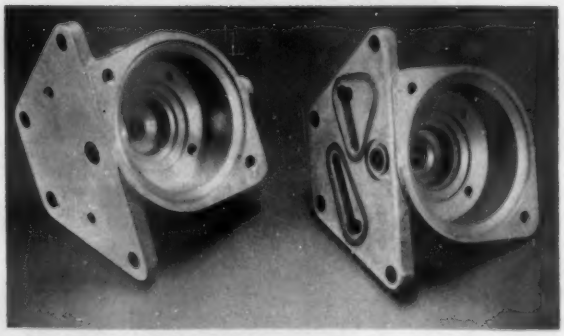
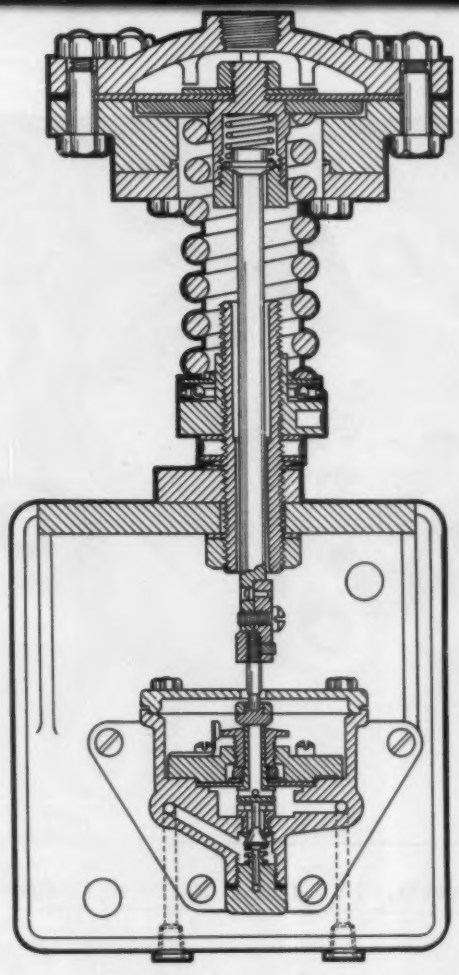


FIG. 4 MACHINING has been reduced to simple clean-up instead of heavy metal removal.



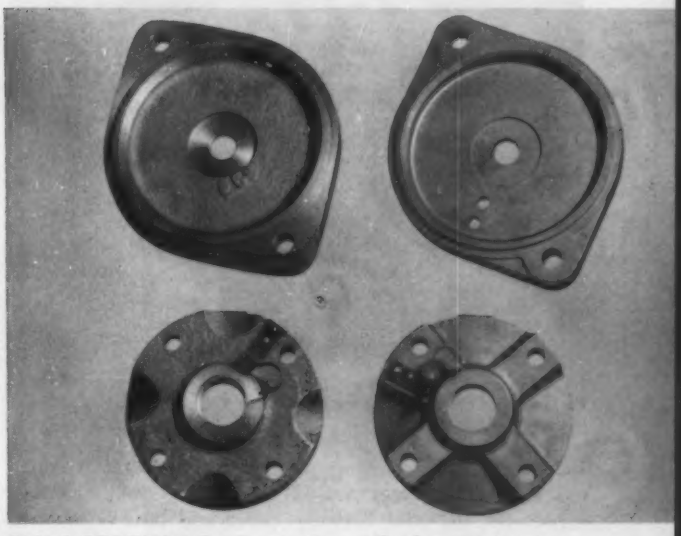


FIG. 2 REDESIGN for die castings made these parts interchangeable.

We didn't know if the die castings would be pressure tight, strong enough, or if the machining savings would be greater than the increased tooling costs.

Redesign was done in steps. First the flange ring and diaphragm plate (Figure 2). These two parts are used on several different instruments and as redesigned are interchangeable. This was one advantage. The diaphragm plate showed savings on casting costs, machining time, and weight and we found machining time savings on the flange ring.

The second redesign phase was on the valve body and covers (Figures 3 and 4). Again there was interchangeability of the bodies, in the field, but a new cover had to be supplied with each new body. Here again casting costs, machining time, and weight were saved.

The final step in redesign was on the base (Figure 5). The savings were in the same classes as before.

Table 1 lists the percentage savings from redesign of the five parts.

But cost savings weren't the only advantages. By changing from No. 43 to No. 360 aluminum alloy the parts are stronger. Table II compares the mechanical properties of the two alloys. Then there's appearance. With smoother surfaces, thinner walls and nicer flow from area to area the entire instrument looks better.

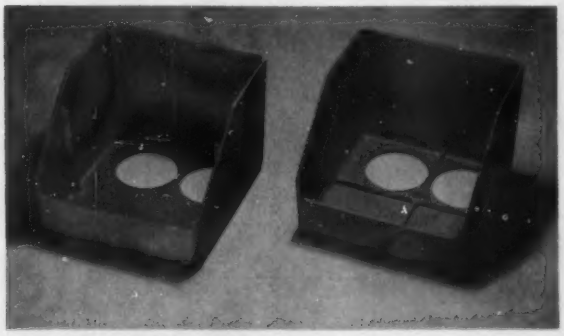


FIG. 5 MINOR MODIFICATIONS of the case gave interchangeability in most cases.

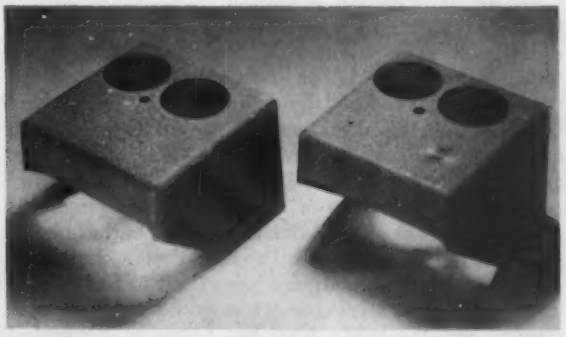


FIG. 6 THINNER, RIBBED walls together with dimensional integrity gave closer joints, a better looking instrument.

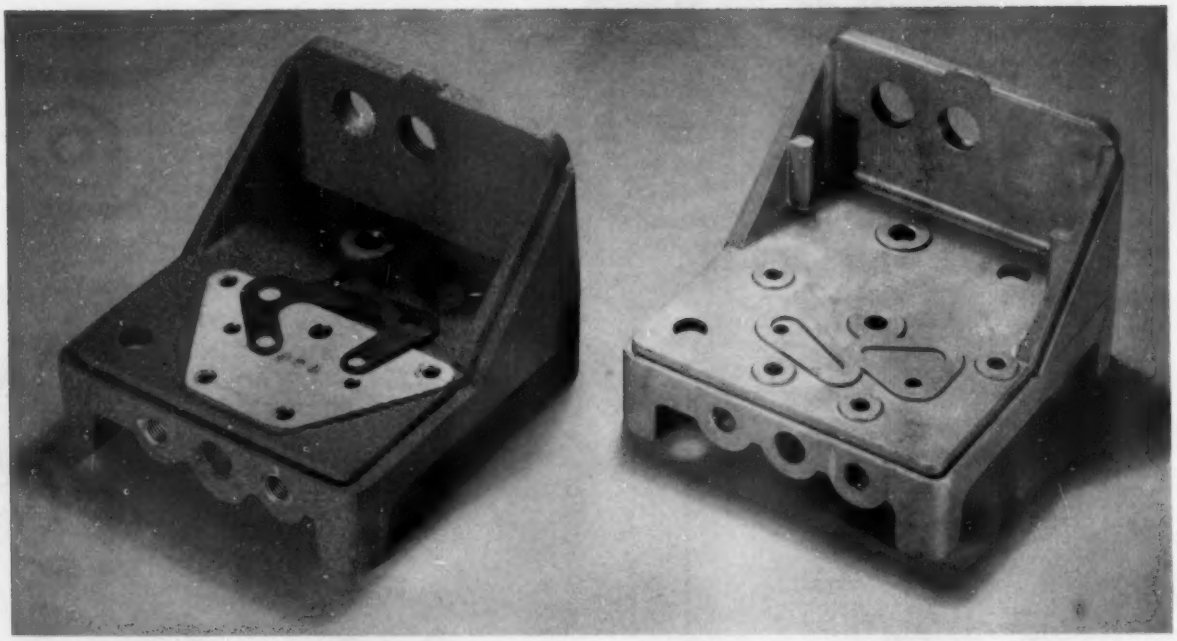


FIG. 7 TAPPING is almost the only machining now needed on the base casting. As-cast surfaces with O-rings make an adequately tight seal.

Because the die casting process makes parts which are exact duplicates and fit better; on the covers, especially, the joint between cover and base is much neater and thinner. Finally an added advantage was a lighter unit. The individual savings in weight are given in Table I and these add up to nearly two pounds saved. Not only is this a dollar saving in metal, but also a major saving in shipping costs.

At first, pressure tightness was a problem. Our supplier, Watchung Die Casting Corp., solved it by modifying the dies to get better metal flow. All of the parts are cast in single cavity molds except the diaphragm plate and flange ring. These two parts have multiple cavity molds.

After casting and trimming all parts are grit blasted on a Wheelabrator airless blast machine. A very fine grit is used and in cases where air tight joints must be made, the surfaces from this treatment are good enough to seal with a standard "0" ring without further machining. Two of the three seals between the body and the base are shown in figure 3.

On the older models of the body two port holes had to be drilled, then the open ends welded closed. The redesigned body eliminated both the drilling and welding operations. Other major machining operations which were eliminated by redesign were milling the base for a flat gasket, most of the lathe operations, and no tap drilling is now required, the cored holes are ready for threading.

A disturbing feature of the older body design was corrosion between the aluminum casting and the brass stems of the gauges. With the new design the gauge connections on the body are not raised to full height. Two low carbon steel connectors go between the aluminum and the brass. This has virtually eliminated

continued on page 92

TABLE I
SAVINGS RESULTING FROM REDESIGN

PART	% Reduction in Casting Costs	% Reduction in Mach. Time	Total % Reduction in Cost (Mach. & Casting)	Weight Saving %
Flange Ring	0%	44%	44%	0%
Diaphr. Plate	36.5%	100%	82.5%	24%
Cover	59%	20%	53%	23%
Cover	62%	19%	56%	12.5%
Base	61%	90%	82%	37.5%
Base	67%	90%	82.5%	37.5%
Pilot Valve Body	60%	62.5%	62%	50%
Pilot Valve Body Complete Incl. Conn. Pieces & O-Rings			48.5%	
All Die Castings	60.5%	82.5%	75.5%	33.5%

TABLE II
TYPICAL MECHANICAL PROPERTIES

	#43 Sand Cast	#360 Die Cast
Ultimate Strength psi	19,000	44,000
Yield Strength psi	8,000	27,000
Elongation (% in 2")	8.0	3.0
Shearing Strength psi	14,000	28,000
Endurance Limit psi	8,000	19,000

STEEL AND SPECIALTY ALLOY EXTRUSIONS

Part II - Chemical Composition and Mechanical Properties

CHEMICAL COMPOSITION and mechanical properties define how well a material will meet functional requirements. The accompanying charts give the chemistry and mechanical properties for many of the most commonly ex-

CHEMICAL COMPOSITION (%)

Group	Grade	Cr.	Ni	C	Mn	Si	Mo	Other
AUSTENITIC STAINLESS STEELS	Type 302	17.-19.	8.-10.	.08-.20	2. Max.	1. Max.		
	Type 304	18.-20.	8.-11.	.08 Max.	2. Max.	1. Max.		
	Type 316	16.-18.	10.-14.	.08 Max.	2. Max.	1. Max.	2.-3.	
	Type 321	17.-19.	8.-11.	.08 Max.	2. Max.	1. Max.		Ti 5 x C Min.
	Type 347	17.-19.	9.-12.	.08 Max.	2. Max.	1. Max.		Cb 10 x C Min.
MARTENSITIC STAINLESS STEELS	Type 410	11.5-13.5	50 Max.	.15 Max.	1. Max.	1. Max.		
	Type 416	12.-14.	50 Max.	.15 Max.	1.25 Max.	1. Max.		
	Type 431	15.-17.	1.25-2.5	.20 Max.	1. Max.	1. Max.		
FERRITIC STAINLESS STEELS	Type 430	14.-18.	.50 Max.	.12 Max.	1. Max.	1. Max.		
AISI CARBON STEELS	C-1010			.08-.13				
	C-1018-20			.15-.23	.30-.90			
	C-1040			.37-.44	.60-.90			
	C-1050			.48-.55	.60-.90			
AISI ALLOY STEELS	4130	.80-1.10		.28-.33	.40-.60	.20-.35	.15-.25	
	4330	.70-.90	1.65-2.00	.28-.33	.60-.80	.20-.35	.30-.50	V .07
	4340	.70-.90	1.65-2.00	.38-.43	.60-.80	.20-.35	.20-.30	
	5150	.70-.90		.48-.53	.70-.90	.20-.35		
	8620	.40-.60	.40-.70	.18-.23	.70-.90	.20-.35	.15-.25	
TOOL STEELS	H-11	4.75-5.25		.37-.43	.20-.40		1.20-1.40	V .40-.60
NICKEL BASE ALLOYS	K Monel		Balance	.15 Max.	1.5 Max.	1.00 Max.		Cu 29.0, Al 3.0, Ti .75
	Monel		Balance	.30 Max.	2.0 Max.	0.5 Max.		Fe 1.4, Cu 30.0
HIGH TEMPERATURE AND SPECIALTY ALLOYS	Inconel	14.-17.	Balance	.15 Max.	1.0 Max.	.5 Max.		Fe 7.0
	A-286	13.5-16.	24.-27.	.08 Max.	1.-2.	4-1.	1.-1.50	Ti 2.0, V .4
	M-252	18.-20.	Balance	.10-.20	5 Max.	.5 Max.	10.0	Co 10.0, Ti 3.0, Al 1.0, Fe 2.0
	René 41	18.-20.	Balance	.12 Max.			10.0	Fe 5.0, Co 11.0, Ti 3.2, Al 1.5, B .008
	19-9DL	18.-20.	8.-11.	.28-.35	.75-1.50	.30-.80	1.50	W 1.50, Ti .25, Cb .40
	17-7PH	16.-18.	6.5-7.75	.09 Max.	1. Max.			Al 1.10
	17-4	15.5-17.5	3.-5.	.07 Max.	1. Max.			Cb .35, Cu 4.0
	15-7 Mo	15.	7.	.09	1.0	1.0	2.5	Al .75-1.50
	Inconel X	14.-17.	Balance	.06 Max.	1. Max.	.5 Max.		Cb 1.0, Fe 7.0, Al .5, Ti 2.0
	Haynes 25	19.-21.	9.-11.	.15 Max.	1.-2.			W 15.0, Fe 2.0, Co Balance
TITANIUM AND TITANIUM ALLOYS	Comm. Pure			.2				.6 Other
	4-4							Al 4.0, Mn 4.0
	6-4							Al 6.0, V 4.0
	5-2.5							Al 5.0, Sn 2.5

truded ferrous metals. Within this group, most industrial applications can be met.

Where it can be applied, the extrusion process will produce parts at the lowest possible cost. Forming dies are inexpensive, especially when compared with forging dies or with rolls. Direct labor costs are very low and much of the labor involved is unskilled.

The severe mechanical working, which results during extrusion, so fully refines the billet grain structure that the best mechanical properties generally result.

Naturally, this group of ferrous alloys will not meet every requirement. Where special alloys are needed, consultation with a custom extruder will often turn up a material which will give the desired properties and which can be extruded.

Through refinements in the basic Ugine-Sejournet process, the H. M. Harper Co. is able to extrude economically many metals formerly considered non-extrudable. Included in this group are the so-called exotic metals as well as specialty steels.

MECHANICAL PROPERTIES

		"AS EXTRUDED" CONDITION (See notes)				HEAT TREATED CONDITION	
Group	Grade	Yield PSI	Tensile PSI	Elongation	Reduction in Area %	Tensile (PSI)	Yield (PSI)
AUSTENITIC STAINLESS STEELS	Type 302	30M	80M	50.0	60.0		
	Type 304	30M	80M	50.0	60.0		
	Type 316	30M	75M	40.0	50.0		
	Type 321	30M	75M	40.0	50.0		
	Type 347	30M	80M	40.0	50.0		
MARTENSITIC STAINLESS STEELS	Type 410	32M	60M	20.0	50.0	90/190M	60/145M
	Type 416	50M	85M	15.0	40.0	90/190M	60/145M
	Type 431	90M	105M	20.0	60.0	125/205M	90/155M
FERRITIC STAINLESS STEELS	Type 430	35M	60M	20.0	40.0		
AISI CARBON STEELS	C-1010	25M	51M	43.0	62.0		
	C-1018-20	36M	62M	38.0	59.0		
	C-1040	50M	90M	24.0	47.0	100M	65M
	C-1050	72M	109M	23.0	35.0	115M/135M	74M/90M
AISI ALLOY STEELS	4130	60M	95M	25.0	56.0	145/180M	135/170M
	4330	99M	119M	17.0	43.0	150/220M	130/200M
	4340	96M	115M	19.0	45.0	140/210M	120/190M
	5150	52M	98M	22.0	43.0	135/158M	121/145M
	8620	86M	58M	29.0	59.0	111/162M	92/142M
TOOL STEELS	H-11					200M	215M
NICKEL BASE ALLOYS	K Monel	60M	105M	30.0		150M	110M
	Monel	40M	75M	40.0			
HIGH TEMPERATURE AND SPECIALTY ALLOYS	Inconel	35M	90M	40.0	50.0		
	A-286	50M	120M	40.0		150M	80M
	M-252	70M	120M			175M	98M
	René 41	120M	160M			200M	150M
	19-9DL	69M	118M	55.0	54.0		
	17-7PH	40M	130M	30.0		215M	200M
	17-4	110M	150M	22.0		199M	163M
	15-7 Mo	55M	130M	30.0		250M	240M
	Inconel X	100M	120M	50.0		162M	92M
	Haynes 25	67M	146M	64.0			
TITANIUM AND TITANIUM ALLOYS	Comm. Pure	55M	65M	18.0			
	4-4	130M	140M	10.0	25.0	160M	150M
	6-4	120M	130M	12.0	25.0	160M	150M
	5-2.5	120M	125M	18.0	40.0		

NOTES: The hardenable grades must be annealed before straightening; therefore, annealed properties are given for these grades in the "As Extruded" condition. As Extruded mechanical properties approximate those of the hot-rolled condition.

PART I

BONDING ALUMINUM TO STEEL

By R. E. SEAL, *Chief Engr., Arthur Tickle Engineering Works, Inc.*

PROBLEM: Needed, a casting with the light weight and heat transfer properties of aluminum, and the strength and wear resistance of steel.

SOLUTION: A bimetallic casting of aluminum and steel, made by the Al-Fin process, which produces a molecular bond between the two dissimilar metals.

In the Al-Fin process molten light metal alloy is cast against a specially prepared surface of a ferrous part. Since its introduction in 1941, when it was used to metallurgically bond aluminum fins to aircooled military aircraft engine cylinders, the process has been developed to the point where any castable aluminum or magnesium alloy (including pure aluminum and magnesium, and alloys such as Alcoa 43, 132, 142, 195, 220, 356, Almag 35, and Frontier 40-E in the aluminum group, and AZ92A, AZ268A, and AZ91C in the magnesium group) can be bonded to gray, malleable, ductile, and austenitic cast irons; carbon, alloy and stainless steels; Inconel; nickel, and titanium.

The process works with permanent mold, dry sand mold, plaster mold, or die castings, and can be handled in any well-equipped light-metals foundry holding an Al-Fin license. It follows standard foundry practice, except for the addition of one extra step—a hot dip of the ferrous part in molten aluminum before the casting is poured.

Hundreds of products have been made successfully by the Al-Fin process. These include brake drums, kitchen utensiles, radar structures, turbines, hydraulic and electrical equipment, gears, and electron tubes.

Usually, the cost of using the process in production doesn't add more than 10 percent to the cost. The extra cost of the bonding operation is often offset by lower preparation costs. No keys, serrations or knurling of the ferrous parts are necessary.

In making an aluminum part with a steel insert, the steel is cleaned in a vapor degreaser and sand- or grit-blasted to remove surface oxides. The area which is not to be bonded is masked with a "stop-off," usually colloidal graphite. The part is then completely immersed in molten aluminum and agitated to insure complete wetting. The aluminum combines with the steel to form a layer of intermetallic compound, 0.001" to 0.0015" thick. The steel bonded part is then transferred to the mold or die as quickly as possible, and the casting made in the usual way. The aluminum bonds to the intermetallic layer.

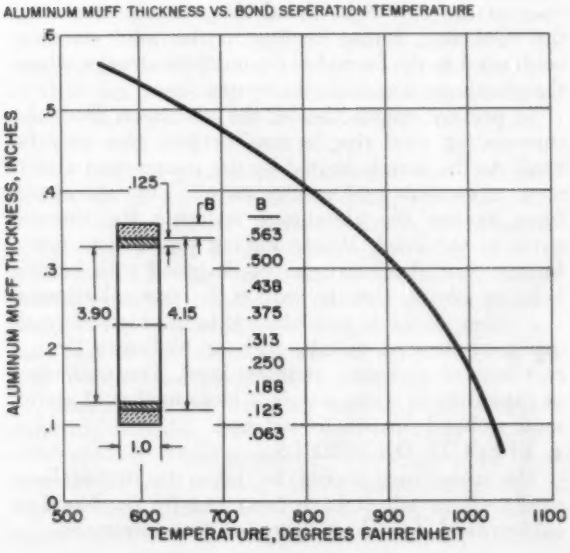
The insert being hot when the metal is poured, contracts proportionately with the aluminum as the casting cools to room temperature, this minimizes stresses.

On some complex castings it is not feasible to place the insert directly from the bond bath and in these cases "reactivation" is used. To "reactivate" the bond the use of flame heat, electrical resistance heat, or furnace heat may be used.

The intermetallic iron-aluminum layer has a tensile strength of about 15,000 psi and shear strength of about 7000 psi. The bond is vibration-proof. It has been tested for oil-tightness up to 3500 psi and pressure-tested at 1000 psi with dry nitrogen.

The metallurgical bond prevents electrolytic corrosion at the interface, which often occurs when dissimilar metals are joined mechanically.

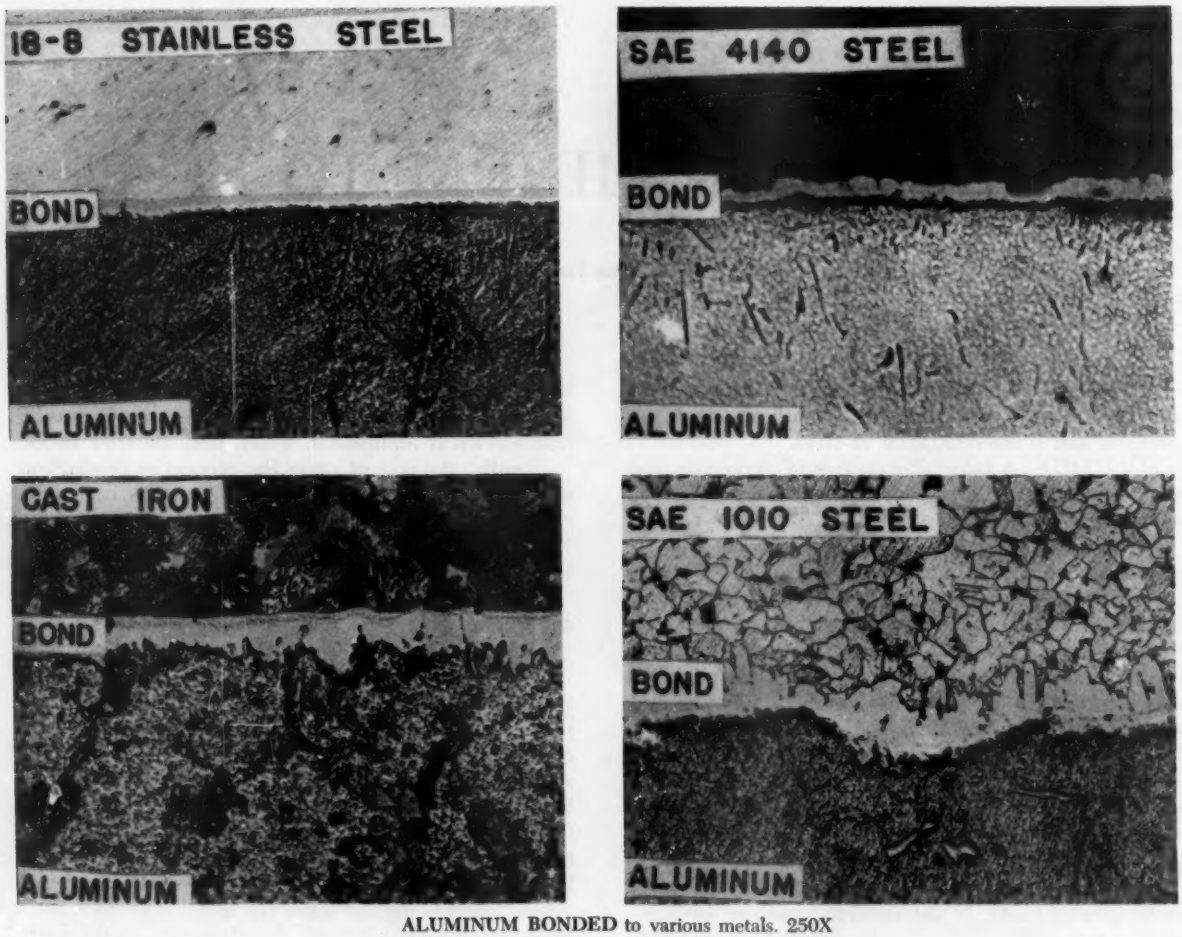
Heat transfer across the interface is 100 percent effective—there is no measurable drop in temperature across the bond.



DESIGN DATA

• SURFACE CONDITION

Aside from cleaning, the surface of the ferrous member usually needs no other treatment. If machined, a standard lathe machined surface of 100 to 200 microinches is satisfactory. Normally, notches or projections aren't needed, except where the aluminum is cast to the inisde diameter of steel shells or where the bonded area is very large; then they're used to reduce shear stress in the bond.



ALUMINUM BONDED to various metals. 250X

• **THERMAL PROPERTIES**

The designer should bear in mind the ultimate bond strength values of 15,000 psi in tension and 7000 psi in shear, and design the part so that at maximum operating temperature of the bimetallic unit the bond stresses do not exceed these values. Bimetallic units are subjected to heat stresses which are direct functions of the difference in thermal coefficients of expansion of the component members, their mass and volume ratios, and the complexities of the designs.

Mass ratios of the components have a direct bearing on the stresses produced; so a construction having thick walls of both metals should be avoided, and either the steel component or the light metal casting should be designed so that there is sufficient elastic deformation to limit the bond stresses.

These stresses can be reduced by various methods. One method is to reduce the relative thickness of one of the members so that it acts as an elastic part of the assembly, as in cooking ware, in which the thin stainless steel vessel deflects as the relatively thick aluminum bottom expands at cooking temperature.

Where considerable heat is rapidly generated in a ferrous liner, as in a brake drum, the surrounding finned aluminum alloy section dissipates the heat quickly, remaining cooler than the ferrous liner and acting as a shrink ring maintaining compressive stress on the bond; in a case like this, heavier thickness ratios are permissible.

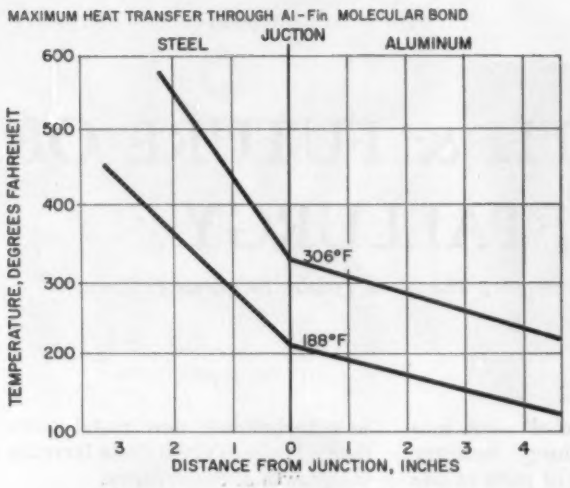
You must use care in designing bonded bimetallic structures in which the steel ring is *outside* a heavy mass of aluminum or magnesium. Here the bond is subject to direct tensile stresses because of the tendency of the cast light metal alloy to separate from the steel ring during cooling to the solid state, as contrasted to the favorable compressive stresses where the aluminum is outside the ferrous liner.

To prevent contraction of the aluminum from the surrounding steel ring, a steel or iron core may be used. As the core is heated by the molten cast aluminum, it expands and creates an opposite restraining force against the aluminum, reducing the thermal stress in the bond. Where it's not practical to use a ferrous core, the insert can be designed with locking holes or keying slots to reduce the thermal stresses.

Another desirable procedure is to use high-thermal-expansion ferrous metals, such as Ni-Resist Type I cast iron or austenitic stainless steel. The coefficient of expansion of these metals is close to that of aluminum, so bond stresses are reduced.

• **EFFECTS ON STEELS**

The usual care should be taken to stress-relieve steel sections which have been heavily machined or cold-worked, to reduce distortion to a minimum.



Data in the tables (right) can be used to design Al-Fin bonded structures. Thermal expansion is most important when the aluminum is inside another material.

average coefficients of thermal expansion of various metals

metal	expansion per °F x 10^{-6}
Steel	6.0-7.0
Cast Iron (gray)	6.0
Ni-Resist, Type I, Cast Iron (Austenitic)	10.7
Stainless Steel (18-8, Type 304)	9.0
Stainless Steel (Ferritic, Type 440)	5.6
Nickel	7.2
Titanium	5.0
Aluminum 99.5%	13.1
Aluminum Casting Alloys	12.0-13.0
Aluminum Piston Casting Alloys	10.0-12.0
Aluminum Casting Alloys (Self aging)	13.1-13.7
Magnesium Casting Alloys	15.0

comparison of hardness values Rockwell C

metal	unprocessed	after Al-Fin process
SAE 4140	32-36	29-32
SAE 4340	32-36	29-32
Type 410 ferritic stainless	40-42	28-30
Timken 1722A(s)	46-48	40-41
Precipitation hardening stainless (17-7 PH)	—	34
Air hardening tool steel	—	40-45
Cast Iron	32	32

In many applications, it is important that the physical properties of the steel member remain unimpaired. Since the bonding and casting temperatures are high enough to partially draw low carbon steels, the more metallurgically stable alloys, such as SAE 4140 and Timken 1722A(s), are recommended for applications where high hardness and strength are required, such as in engine cylinder barrels and steel pivot shaft members for guided missile fins. For example, cylinder barrels made of SAE 4140 steel are heat-treated to a hardness range of Rockwell C32-36. After Al-Fin processing, the specified range is Rockwell C29-32.

The Timken 1722A(s) steel is prehardened to Rockwell C46-48; after Al-Fin processing it drops to C38-42. If higher hardness is desired, the ferrous member can be made of air-hardening tool steels, such as Allegheny-Ludlum's Super Panther or Universal Cyclops' Sparta, which can be supplied with hardness in the range of Rockwell C40-45 after Al-Fin processing. The 17-7PH heat-treatable stainless steel can be heat-treated to Rockwell C34 after Al-Fin processing.

• SURFACE PROTECTION

For most applications, aluminum may be used without finish and protective coating, due to the natural formation of the inert aluminum oxide on its surface. However, supplementary protective finish coatings can be applied to the bimetallic part where there is expectation that the oxide film may be attacked or destroyed by corrosive environments. Also, the ferrous part of the bimetallic unit, if not stainless steel, may require a corrosion-resistant coating.

There are suitable finishing processes and materials currently available, and they are easily and economically applied. Two proprietary processes have been successfully used and meet Government Service Specification MIL-C-5541; from a salt spray performance requirement they are comparable to chromic acid anodizing. The processes are Alodine 610 and Iridite, 14.

In order to more fully protect the ferrous insert and to prevent cross-over electrolytic attack between the aluminum and the insert, the bimetallic part should be plated, preferably with cadmium, before applying the oxide film.

Electrolytic oxide anodic processes, such as acid anodizing, generally are not advisable, because the acid anodizing bath severely attacks the ferrous insert.

• DESIGN CONSIDERATIONS

A primary consideration is that the ferrous insert is hot as it is placed in the mold, and therefore, does not act as a chill member, but actually introduces heat into the casting and retards cooling. Accordingly, risers large enough to feed the hot critical areas should be used.

It's important to avoid pattern intricacies, where air might be trapped and oxidize the part or prevent the molten aluminum from fully flushing the surface.

Consideration must be given to the difference in expansion coefficients between the light metal and the ferrous metal used. Attention must be paid to foundry techniques and mold design so that the hot ferrous member can be located and the mold closed with a minimum of delay.

Since it will not be possible to subject the bimetallic unit to a solution-type (T6) heat treatment, because of the resulting thermal shock to the bond during the quenching, designers should specify alloys that can be used in the as-cast condition or that will show increase in hardness and other physical properties after artificial aging (T5) treatment.

• NOTCH EFFECTS

The usual caution against notch effects applies to bimetallic castings. They should be avoided by using generous fillets, rounding sharp corners, and carefully blending sections that carry the main stresses.

Part II of this report will appear in the July, 1960 issue.

ROLL

THE GROWTH & FUTURE OF POWDER METALLURGY

By KEMPTON H. ROLL, *Executive Secretary The Metal Powder Industries Federation*

THE GROWTH OF AN INDUSTRY can be measured by its consumption of raw materials. When any industry eats up its basic material at a rate faster than general industrial growth—that industry is growing.

For the powder metallurgy industry, then, we turn naturally to the consumption of metal powders as a measure of growth.

Statistics are available for iron powder since 1948 and for copper powder since 1952. These are shown in figures 2 and 3. But these figures tell only a part of the story. Total metal powder consumption by industry is not a measure of powder metallurgy since other uses such as welding electrodes and flame cutting take a big part of the iron powder produced. Let's see how end uses were distributed in 1959; Figure 1 shows this division. Slightly over half of the iron powder produced went into the powder metallurgy industry for the manufacture of parts of one sort or another. This does not include electronic and magnetic applications. When these two are lumped together the industry used up almost 60% of the total iron powder production.

Now how about copper powder. This material is basic for the production of self-lubricating bushings. The statistics are, unfortunately, confusing since the latest ones lump grain and flake together.

In addition to copper and iron powder, there is marked activity in stainless steel, brass, and nickel silver powders. These fields will, unquestionably, grow rapidly.

This brief statistical picture shows how far, and how rapidly powder metallurgy has grown. Its future is unpredictable, except that it will be up. New applications, new techniques, new metal powders all help to maintain or increase the growth of the industry.

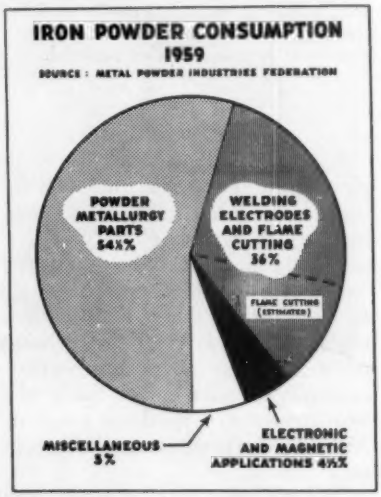


FIGURE 1

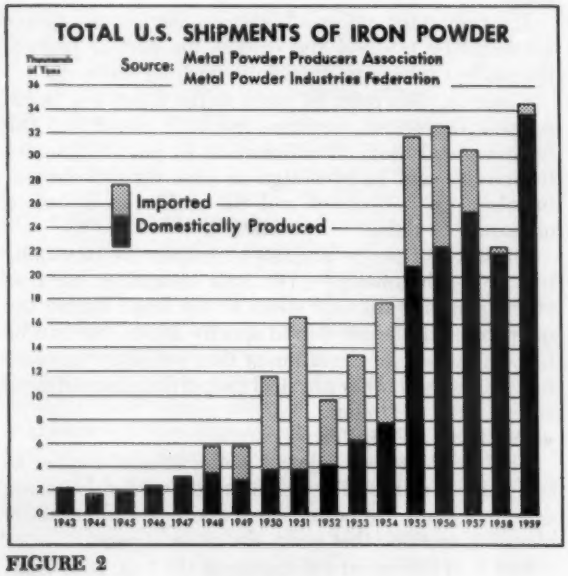

TOTAL U.S. SHIPMENTS OF IRON POWDER
Thousands of Tons
Source: Metal Powder Producers Association
Metal Powder Industries Federation
Imported
Domestically Produced
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959

FIGURE 2

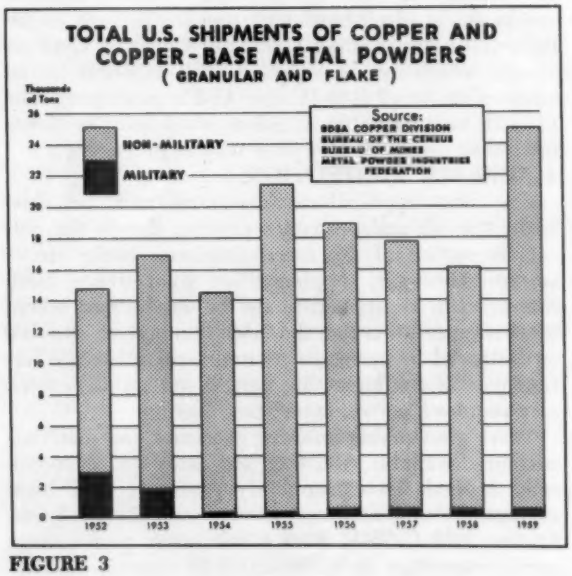
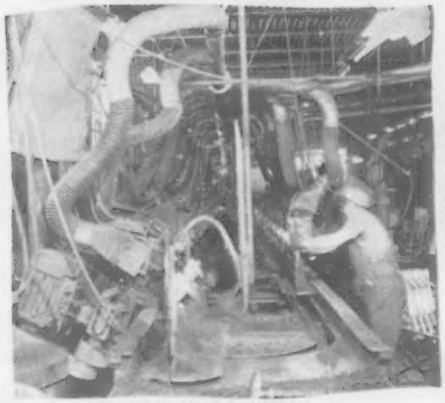

TOTAL U.S. SHIPMENTS OF COPPER AND COPPER-BASE METAL POWDERS
(GRANULAR AND FLAKE)
Thousands of Tons
NON-MILITARY
MILITARY
Source:
BDSA COPPER DIVISION
BUREAU OF THE CENSUS
BUREAU OF MINES
METAL POWDER INDUSTRIES FEDERATION
0 2 4 6 8 10 12 14 16 18 20 22 24 26
1952 1953 1954 1955 1956 1957 1958 1959

FIGURE 3



AUTOMATIC BUFFING

TRIMMING

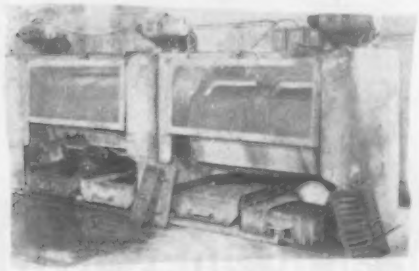
AUTOMATIC PAINTING

The specialized finishing metals, equipment and materials used to machine, assemble, surface condition or surface coat precision metal molded parts are presented here.

PMM

FINISHING SECTION

MACHINING OUTBOARD CASTINGS PAGE 51



BARREL FINISHING

SPRAY PAINTING

PLATING

HAND BUFFING

This includes all secondary operations which convert a raw casting to a finished casting.

MACHINING

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2. Prevents cloudy, stained nickel plate
3. Provides good adhesion on zinc die castings, copper and brass
4. Descales heat-treated, welded, or brazed steel without attack
5. Allows re-nickel plating on top of old passive nickel plate
6. Dissolves red rust
7. Activates steel prior to plating or phosphating
8. Prepares cast iron for plating
9. Removes soldering flux

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MACHINING OUTBOARD CASTINGS

By H. K. BARTON, *Roughfield Etchingham Sussex, England*

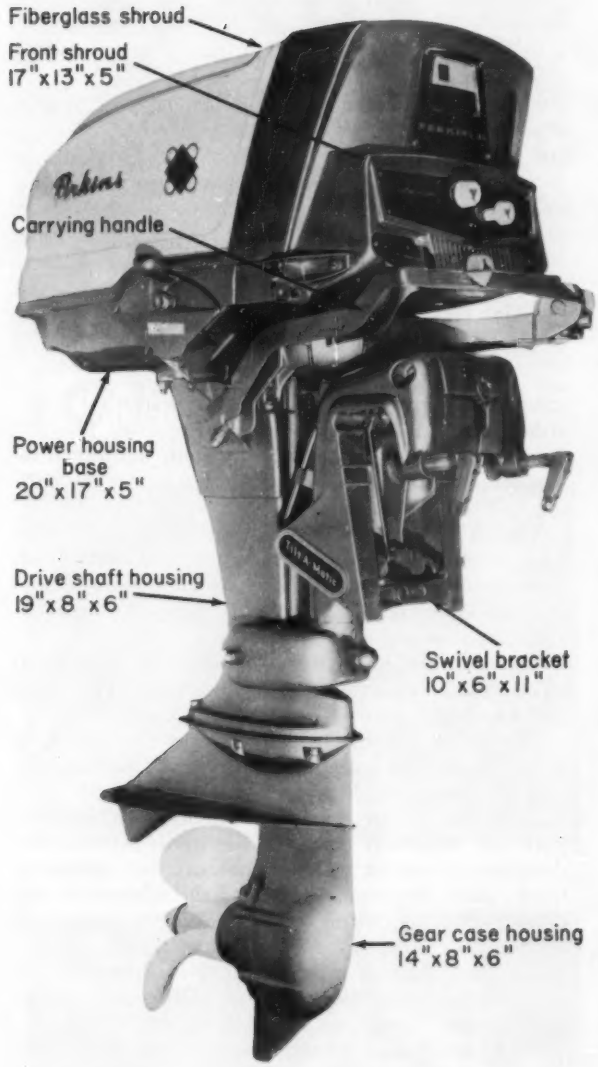

FIGURE 1 DIE CASTINGS from top to bottom, this Perkins (Oliver) outboard engine is precision machined at high production rates, but high quality is maintained at all times.

THE OLIVER OUTBOARD motor used to be produced in Chicago. Now it's made by F. Perkins, Ltd. in England.

When Perkins purchased the Oliver outboard they got everything, including the machine tools required to machine the parts. All of these tools had to be shipped to England and set up in a new plant. But while this went on, manufacture and distribution of Oliver outboard motors had to continue smoothly.

The Oliver line was three sizes of outboard motors, six, sixteen, and thirty-five HP. To make the shift from Chicago to Peterborough, England required first of all a stock of components for all three models, completely machined and finished in the U.S. plant and ready for assembly. Second, a parallel stock of unmachined components, including the many die cast aluminum parts, was produced in the U.S. and shipped to Britain. Finally, while assembly continued in England, the special-purpose machine-tools from the production lines were taken over and installed at the British plant. Some additional machines were added from the Perkins Eastfield Diesel plant and a few specially purchased items.

Before the stock of premachined and finished parts was exhausted, machining of the rough parts started so that there was no interruption of parts flow to the assembly line.

Almost all of the structural parts of the largest model (35 HP) in the Perkins range, and a preponderance of those in the other two sizes, are die cast in aluminum. Many of these are both large and complex; it is probable that the outboard motor industry is well ahead of the automobile builders in taking the fullest advantage of the scope offered by die casting.

The dies used to produce the main castings are massive, and elaborately cored even by U.S. standards. For the 35HP cylinder block, for example, production in the U.S. was on an 800 ton Cast-Master machine.

The choice of a contract die caster to produce the components from American dies was, therefore, limited. Only a relatively small number of British shops operate machines in this size range. The production of the largest components finally went to a Birmingham company with experience in the operation of very large dies. Members of their engineering staff went to the United States to study the production of castings from the dies under American conditions. In the Bir-

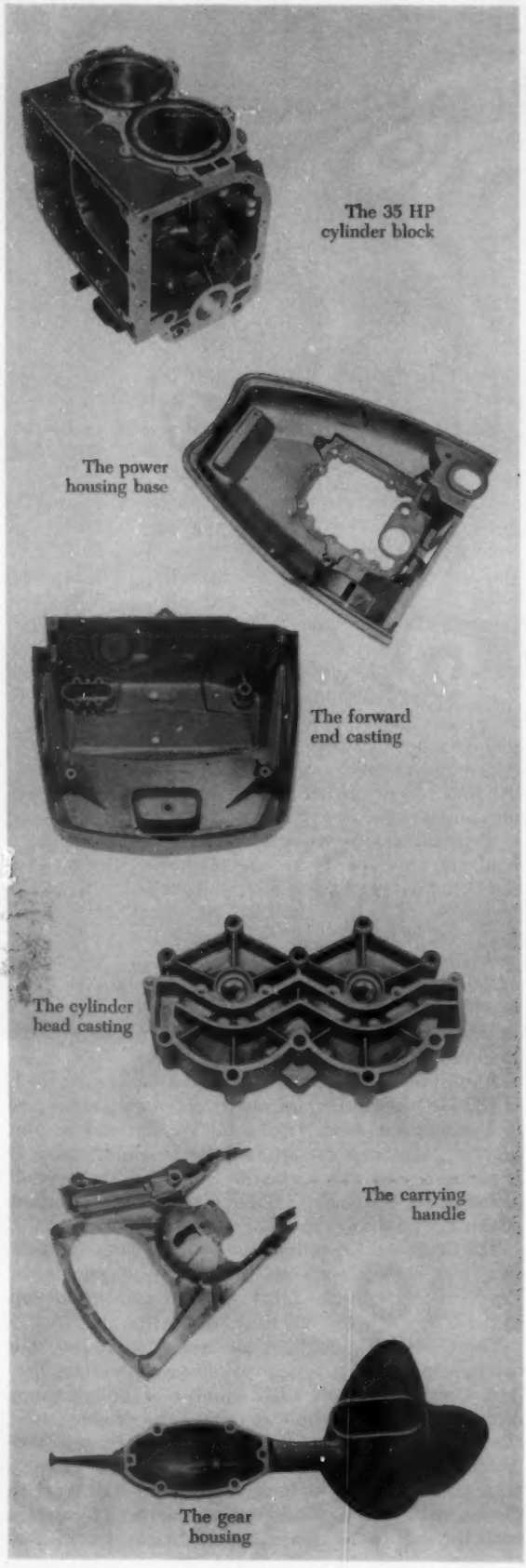

TABLE I
DIE CAST COMPONENTS OF 35 HP. ENGINE

Part	Approx. size (in.)
Intake manifold	6 x 4 x 2
Gear case housing	14 x 8 x 6
Swivel bracket	10 x 6 x 11
Exhaust jacket cover	8 x 6 x 1
Pivot tube	
Water pump body	3 x 3 x 2
Cold water pump	3 x 3 x 1
Handle bracket (top)	4 x 4 x 2
Throttle control lever	8 x 2 x 2
Tip up handle	6 x 2¾ x 2
Drive shaft housing extension	8 x 4 x 5
Cylinder head	10 x 8 x 3
Bearing carrier	
Crankcase	10 x 7 x 4
Cylinder block	10 x 10 x 8
Intake port cover	8 x 6 x 1
Drive shaft housing	19 x 8 x 6
Carrying handle	14 x 13 x 4
Side bracket	2 x 3 x 2
Fuel pump body	3 x 2 x 1¾
Starter bracket standard	5 x 4 x 2
Front shroud	13 x 17 x 5
Latch	2 x 1 x 1
Pinion carrier	5 x 3 x 1¾
Power housing base	20 x 17 x 5
Gear shift handle	3 x 2¾ x 6
Cover	2 x 1 x 1

mingham shop, the large dies are now run on a machine rated at 1000 tons locking pressure. The 25% increase in locking pressure gives some additional insurance against dimensional variation across the parting line of the castings..

The 35 HP outboard motor (figure 1) is a two cycle type. It is a watercooled, twin cylinder unit which develops maximum horsepower at 4,500 rpm. It, and the two other models in the line, has a forward, reverse, and neutral gear shift.

The shrouds are molded in fiberglass reinforced plastic for lightness and sound insulation. The name and motif are chromium plated zinc die castings.

The power housing, which contains the engine, is in two parts. The base and forward end, both are die cast in aluminum. Below these are the drive shaft housing and the propellor drive housing. These two parts are intricately cored on the inside with hydrodynamically correct external contours. In addition to these main structural elements, the elaborate and rugged pivoting, tilting and clamping gear are all produced as aluminum die castings. Some of the more outstanding castings are illustrated in figure 2. The complete list of die castings with approximate dimensions (based on projected area) are given in Table I.

Since one of the outstanding advantages of die casting is that it can reduce or even eliminate many machining operations, some of the components require only drilling or tapping to prepare them for the assembly line. However, the level of precision with which these operations are carried out is critical to the correct assembly and efficient operation of the engine.

FIGURE 2 SOME OF THE DIE CASTINGS which go into the engine. The complex design is required for proper functioning and low cost production. Only die casting could produce them economically.

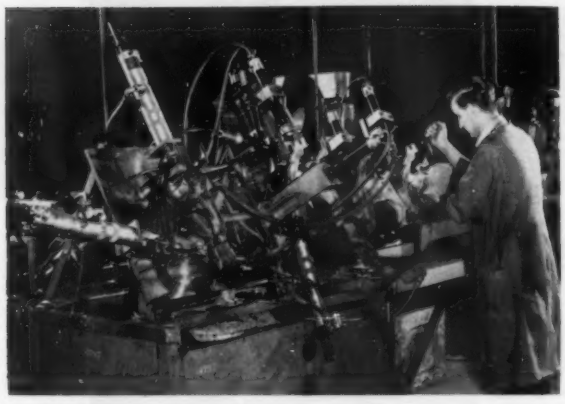

FIGURE 3

MACHINING STARTS at a drilling and tapping machine on which the handle for the 35 HP motor is machined. This set-up has eleven air-operated drill units set at compound angles to the tilted base-plates. Each station is provided with pneumatic clamping and the operator has only to move each component one place to the right at each cycle. This machine is typical of the special purpose units which can be built up from standard components. As the design changes, the air operated drill units can be relocated, where necessary. Drilling, tapping, reaming, and end milling can all be done on this general type of machine. The individual units may operate simultaneously or in predetermined sequence (fig. 3).

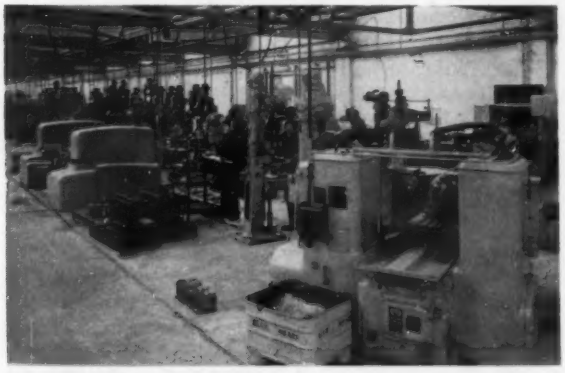

FIGURE 5

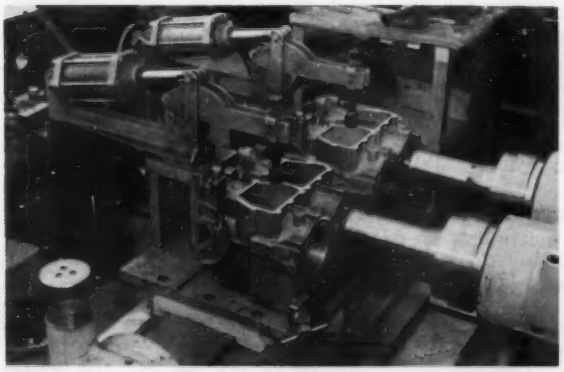

FIGURE 6

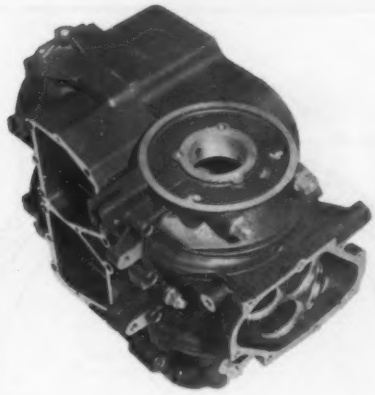

FIGURE 4

THE MOST CRITICAL machining is on the cylinder block and crankcase. These are shown assembled in figure 4. In figure 5 the assembly line on which the block and crankcase machining is done is shown. The two die castings have a combined weight of 23 lb., the cylinder block alone, with its cast-in liners, weighs 19 lb. The rough castings are inspected before machining and are pressure tested at 20 psi. Then they are washed in a Dawson washer and dip Bonderized. After drying, they pass to a Cincinnati 3/24 duplex miller. Machining is done with two 10 in. diameter Galtona face mills. This machine finish-mills the crankcase and cylinder-head faces of the block in a single pass.

The next operation is to ream two dowel holes to 0.3750/0.3745 in. with an end-cutting reamer on a Herbert "C" type drilling machine. This operation is very critical since these holes are used to locate the block at other operations.

The castings then pass to a three-station set-up on a Wadkin Vertical mill. Here the assembly faces on three of the remaining four sides of the block are machined. Next the blocks go to a Pollard single-spindle drill for spotfacing of a lug before the cylinder liners are bored.

BORING THE CYLINDERS is a more complex sequence of operations. The blocks are loaded on a two-station Heald fine borer, see figure 6. The cylinders are rough bored to 3.036/3.038 in. on the first station.

Now instead of going to the finish boring station the blocks are transferred to a special Excello machine. Here sixteen port-holes are drilled through the wall of the die casting and the underlying cast iron cylinder liner. To avoid run-out, the die cast wall is locally increased to form a pad. As shown in figure 7, the face of the pad is normal to the drill axis at each port location.

After the ports are drilled, the block is returned to the Heald machine. The cylinders are finish-bored to 3.0610/3.0600 in.

Next, the front end of each cylinder is undercut and chamfered with a Scully Jones recess tool. After two minor drilling operations the blocks go to a Herbert four-spindle drilling machine. On this machine, sixteen tapping, two drilling and three reaming operations are done. There is a second four-spindle se-

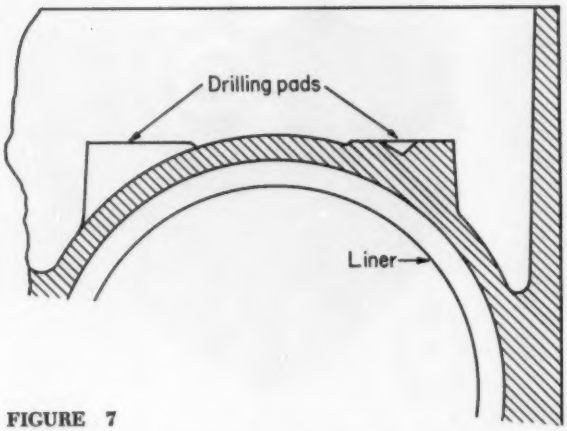

FIGURE 7

quence, then a single ¾ in. dia. hole is drilled and finally an oil slot is milled across the crankcase face of the block on the Wadkin router shown in figure 8.

After this final machining operation the blocks are given a second water pressure test to make sure that the machining operations did not open any leaks.

THE CRANKCASE CASTING, after inspection, pressure tests, and preliminary drilling operations on an Archdale radial, is washed and Bonderized. After drying it is ready for the main machining sequences.

First the top and bottom faces are milled on a Wadkin vertical mill as shown in figure 5. The casting then goes to another special purpose Excello machine, figure 9, where it is drilled, reamed, and spot-faced.

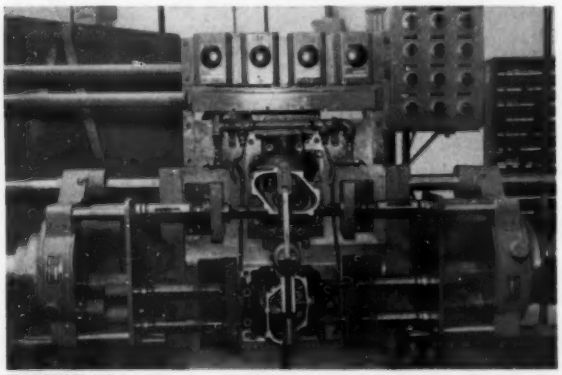

FIGURE 9

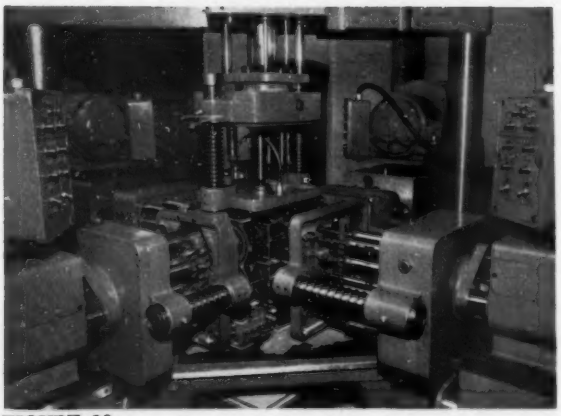

FIGURE 10

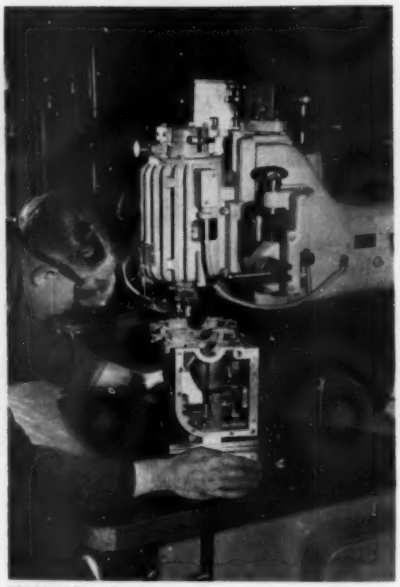

FIGURE 8

A two station fixture is used. On the fixture, an air operated clamp of the cross-head type, holds two castings in position and automatically rotates through 90° to allow free removal of the parts as soon as pressure is released. This machine, like all others in the production line, is push-button controlled.

Now the crankcase goes to an Archdale four-spindle machine where two holes are reamed at each station.

The last operations on the individual crankcase casting is to ream three holes and drill one hole. These operations are done on a two-spindle Pollard.

The crankcase and cylinder block are now assembled. If necessary the joint faces are lapped. The crankcase is held to the block with four ¾ in. studs and the nuts tightened uniformly to 260 in. lb. with a torque wrench. This assembly then goes to an Archdale milling machine where the lower face is surface milled. Three holes are drilled, using a template and a hand operated pneumatic drill.

The next operation is one of the most critical in the entire engine machining operation; bore and face the crankshaft bearings. This job is done on a Precimax fine borer. The first rough bore is to 1.730/1.720 in. for the near bearing and 1.605/1.595 in. for the far bearing. The bearing faces are now finish machined. Finally the two bearings are finish bored to 1.7490/1.7480 and 1.6852/1.6847 in. The face is machined to 3.819/3.814 in. diameter. The assembly then goes to a B & T fine borer for rough and finish facing of the other end.

The block and crankcase assembly now go to a special Heald Boromatic, figure 10, where 54 holes are drilled simultaneously by six heads. An almost identical machine is then used to tap 63 holes. The machining speed possible on these castings with specially designed machines is well illustrated by the time for these last two operations. Floor-to-floor time for both drilling and tapping is one minute, sixteen seconds.

The remaining operations are simple. The guide holes and recesses for the valve seats are bored.

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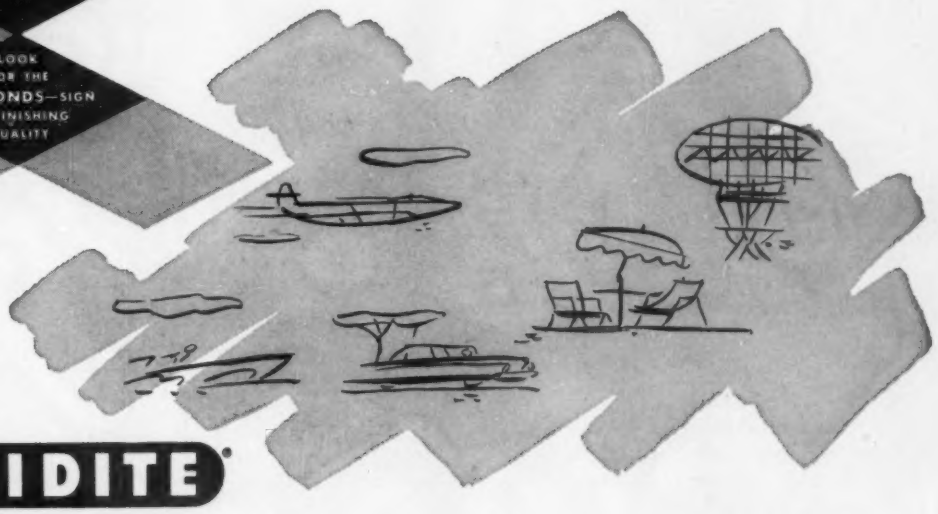

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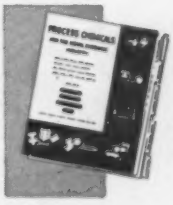

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An example of the saving possible through the use of adhesive bonding of die castings is a cast pump part. This part was designed as a green sand casting. Because of the complex interior design, blow holes were common and reject rates ran up to 25%. On a run of 1000 castings a 25% reject rate cost over $750.00.

The part was redesigned to use three simple die castings. They were assembled with an epoxy resin base adhesive (Minnesota Mining & Mfg. Co.'s EC-1386 adhesive). The result, no rejects, machining costs greatly reduced, and separate sealing and gasketing eliminated.

Other advantages of adhesive bonding were the use of unskilled labor instead of high-priced machinists, high temperature welding and brazing eliminated, corrosive fluxes eliminated, and in many cases lower cost materials could be used.

How about adhesive costs—on the pump part shown the cost was 3.2 cents per part. Without any other saving, that means spending $32.00 for adhesive to save $750.00 in rejects.

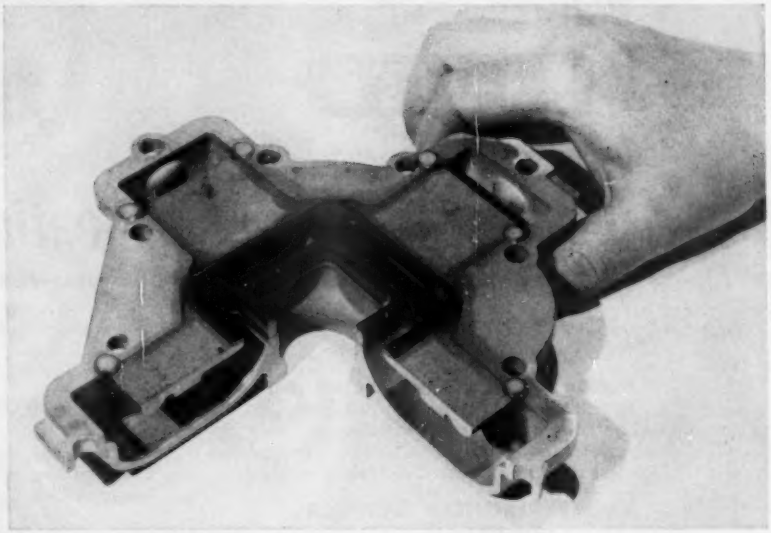

FIG. 1 THREE DIE CAST components assembled by adhesive bonding to replace a single sand casting.

FIG. 2 HOW THE JOINTS are made. Adhesive is applied to a shoulder joint on the casting. The "X" shaped part put in place, more resin applied to the edge of the "X" and the square wear plate assembled.

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continued from page 20

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continued on page 60

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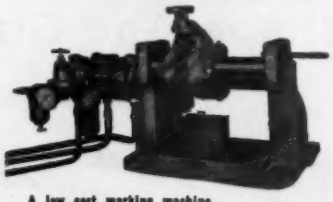

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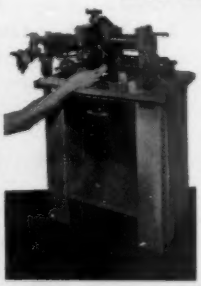

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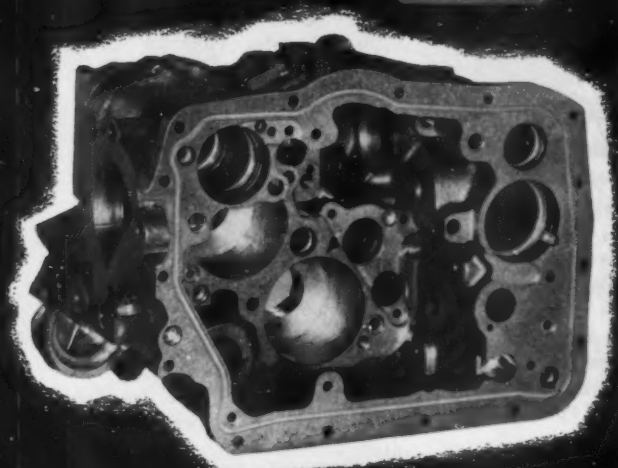

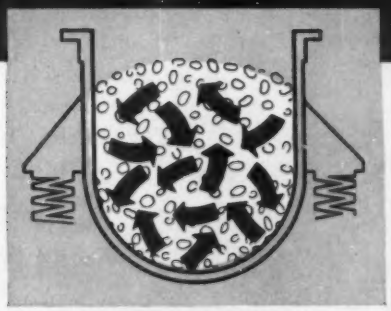

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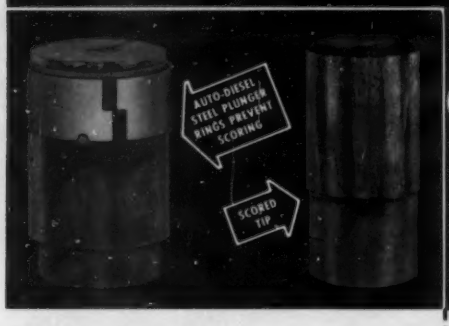

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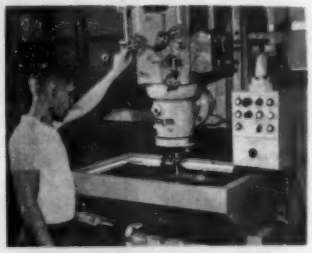

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MATERIALS & EQUIPMENT

151 Wax Injection Press — ALEXANDER SAUNDERS & CO. — Engineering data, specifications and prices on the Sherwood Model WP-60 wax injection press.

152 Temperature Conversion — FANSTEEL METALLURGICAL CORP. — Chart converts between Centrigrade and Fahrenheit temperatures, lists engineering properties of tungsten, tantalum, molybdenum and columbium.

153 Exalene Gas Producers — GENERAL ELECTRIC CO. — 4-page bulletin describes exalene gas producers for bright annealing, normalizing, brazing and sintering of copper, brass and low-carbon steels.

154 Cooling Unit — BIJUR LUBRICATING CORP. — Data on the Spraymist self-contained mist coolant unit.

155 Material Testing — W. C. DILLION & CO. — Engineering data and prices on an expandable work platform for testing materials in tension, compression and shear.

156 Carbide Tools — PRECISION CARBIDE CO. — 14-page catalog and price list on Pre-Carb solid carbide tools, includes technical data.

157 Generator Brush — HANSON-VAN WINKLE-MUNNING CO. — Bulletin describes the Equaload coated generator brush which reduces commutator wear and threading, includes technical data.

158 Diamond Grinding — ENGELHARD HANOVIA, INC. — Monthly technical publication discusses the application and cost of diamond grinding.

159 Electric Furnace Control — MINNEAPOLIS-HONEYWELL REGULATOR CO. — Technical data on the Electro-O-Volt unit for current-proportioning control of electric furnaces.

160 Heating Element Alloy — HOSKINS MFG. CO. — 8-page technical report describes how Chromel-AA nickel-chromium alloy was developed for use in controlled atmosphere furnaces.

178 Permanent Magnets — WESTINGHOUSE ELECTRIC CORP. — 8-page technical bulletin describes a line of permanent magnets, their fabrication and application.

179 Wire Cloth — CAMBRIDGE WIRE CLOTH CO. — 102-page catalog on wire cloth, includes information on its fabrication and application.

180 Carbides — CHROMALLOY CORP. — Technical bulletin tabulates the properties of two new stainless steel-bonded carbides.

181 Flaw Detector — UNITED STATES CASTING REPAIR CORP. — Data on a unit for detecting surface and sub-surface cracks and defects in any ferro-magnetic metal.

182 Nickel-Chromium Alloy — HOSKINS MFG. CO. — Information on a modified 80-20 type nickel-chromium alloy having optimum uniformity of all electrical, physical and mechanical properties.

183 Air Cylinders — BIMBA MFG. CO. — Data on stainless steel air cylinders that are compact, low priced and available from stock.

184 Testing Cabinet — W. C. DILLION & CO. — Engineering data on a controlled temperature cabinet for testing specimens in compression, tension or shear.

195 Diamond Pins — TITAN TOOL SUPPLY CO. — Data on diamond pins for the precision grinding or hardened steel, ceramics and carbides.

211 Thermometer—W. C. DILLON & CO.—Engineering data on a 6 ft. stem, stainless steel thermometer for measuring temperatures in deep recesses.

212 Graphite Tube Furnaces—HARPER ELECTRIC FURNACE CORP.—Bulletin describes research and production graphite tube furnaces for temperatures to 5000°F.

213 Vacuum Gauge Calibration—NRC EQUIPMENT CORP.—Information on a universal test bench for calibrating vacuum gauges.

214 Pyrometer Calibration—PYROMETER INSTRUMENT CO.—Catalog describes a test set for calibrating optical pyrometers in the field.

215 Dynamometer—W. C. DILLON & CO.—Information on a 100 ton, traction-type dynamometer includes a design manual of dynamometer applications.

216 Heating Elements—MORGANITE INC.—Technical data on a new type silicon carbide electric furnace heating elements, includes performance characteristics.

continued on page 64

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"QUALITY CONTROL OF INVESTMENT CASTINGS" BULLETIN.

Details eight control requirements for quality investment castings, major phases for production to meet quality control, process variables and their effect on quality.

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"DIMENSIONAL CONTROL OF INVESTMENT CASTINGS" BULLETIN.

A realistic approach for the product designer.

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RESEARCH

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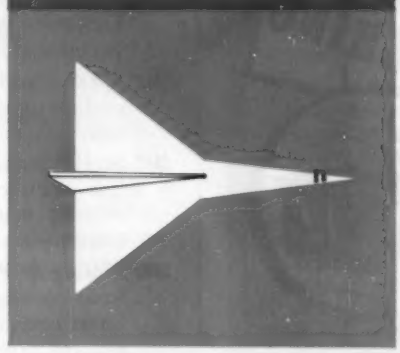
PERFORMANCE



"GAGE CONTROL" BULLETIN.

Details procedures to meet the increasing demand for dimensionally accurate castings of complex and intricate shapes, by the highly specialized function of design and gage control.

Circle No. 103 on Reader Service Card

"CERAMIC SHELL USE" BULLETIN.

A case history of advantages of production of castings in ceramic shell molds.

Circle No. 104 on Reader Service Card

"VACUUM CASTING TAMES SUPERMETALS" BULLETIN.

Tells how hard-to-forge, hard-to-machine alloys can often be vacuum investment cast.

Circle No. 105 on Reader Service Card

"SOLUBLE CORES: HOW AND WHERE USED" BULLETIN.

Detailed, diagrammed information, illustrates the increased freedom of design permitted with the use of soluble cores.

Circle No. 106 on Reader Service Card

"DESIGNING HOT ENGINE PARTS" BULLETIN.

Report on forming of parts that cannot be made any other way. Gives facts on benefits of longer part life, reduced scrap losses.

Circle No. 107 on Reader Service Card

"TOOLS AT WORK" BULLETIN.

Covers preparation of patterns, molds, the MONO-SHELL process, X-ray inspection, and finishing.

Circle No. 108 on Reader Service Card

"QUOTING FOR PROFIT" BULLETIN.

Presents all the elements which go into quoting on production of investment castings, to meet performance demands.

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Sales Offices in Principal Cities

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217 Heating Unit—C. I. HAYES, INC.—Data on a high-frequency generator induction heating unit for instantaneous, uniform, precise surface heating.

218 Temperature Indicators—MARKAL CO.—Information on precision temperature indicators that melt at predetermined temperatures.

219 Magnetic Testing—MAGNAFLUX CORP.—Literature on ready-to-use materials in spray cans for Magnaflux and Magnaglo testing.

220 Dust Collector—HAMMOND MACHINERY BUILDERS, INC.—16-page catalog tells how to achieve the best results with their line of dust, dirt and mist collecting units.

221 Decimal Equivalents—NEWTON-NEW HAVEN CO.—Chart of decimal equivalents die cast from zinc alloy doubles as a paper-weight.

222 Degassing Compound—FOUNDRY SERVICES INC.—Technical data on a compound for removing hydrogen and other gasses from molten metal.

Photomicrography—EASTMAN KODAK CO.—46-page technical booklet for 60¢ reviews the latest techniques in photomicrography.

224 Melting Furnaces—INTERNATIONAL FOUNDRY SUPPLY CO.—20-page brochure describes a line of oil, gas and coke furnaces for low-cost melting.

225 Stainless Steel Filters—PALL CORP.—Technical data on porous stainless steel filters designed for maximum filtration with minimum filter volume.

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FINISHING

185 Carbon Arc Welding — THE ARCAIR CO. — 12-page manual tells how to weld with a twin electrode carbon arc torch.

186 Drilling & Tapping — UNIVERSAL-AUTOMATIC CORP. — 12-page catalog describes the benefits of using automatic, high-speed drilling, tapping and threading machines.

187 Mask Washer — CONFORMING MATRIX CORP. — Brochure describes machines for the high pressure spray washing of paint masks.

188 Aluminum Casting Pickle — CONVERSION CHEMICAL CORP. — Bulletin tells how to use Kenvert No. 45, a new non-fuming pickle for aluminum castings.

189 Barrel Finishing — TUMB-L-MATIC INC. — Technical bulletins describe a complete line of barrel finishing equipment.

190 Cadmium Plating — HANSON-VAN WINKLE-MUNNING CO. — Technical data on the Cadalume L process for faster bright cadmium plating and improved deposit distribution.

191 Chromium Plate Finishing — LEA MFG. CO. — Data sheet on abrasive finishing methods for producing bright, satin or butler finishes on heavy chromium plate.

192 Vacuum Plating — PLASTIC ART METALLIZING CORP. CORP. — Brochure describes the preparation and process steps needed to vacuum metallize parts.

193 Self-Tapping Screw — SET SCREW MFG. CO. — Bulletin describes a self-tapping set screw designed to cut production costs and eliminate tapping problems.

194 Metal Finishing — CONVERSION CHEMICAL CORP. — Reference chart lists Kenvert metal finishers for chromate treatments, bright dips, cleaning and other operations.

200 Plating Solution Analysis—HANSON-VAN WINKLE-MUNNING CO.—36-page guide for non-technical personnel tells how to analyze plating solutions.

201 Spray Finishing—CONFORMING MATRIX CORP.—Literature on an automatic spray finishing unit using conveyor mounted work holders.

202 Steel Cleaner—ENTHONE, INC.—Data on an alkaline electrocleaner with chelating agents for removing smut, rust, oxides and welding scale from steel.

203 Plating & Polishing—HANSON-VAN WINKLE-MUNNING CO.—publishes a 4-page periodical on their latest equipment, supplies and processes for plating and polishing.

204 Grinding & Buffing—MURRAY-WAY CORP.—Brochure describes a unit for automatic buffing, grinding or deburring on a production basis.

205 Heat Treating—DREVER CO.—16-page bulletin describes the latest methods and equipment for continuous, semi-automatic and batch heat treating of stainless steel.

206 Nickel Anode—HANSON-VAN WINKLE-MUNNING CO. —Bulletin describes a new shape nickel anode with longer life and lower scrap loss.

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Advanced Jewelry Casting Co.

All Metal Precision Casting Corp.

Alloy Steel Casting Co.

Artco, Inc.

Arwood Corporation

Mercast Division
Arwood Corporation

Austenal Co.
Div. of Howe Sound Company

Allen Benjamin Metallurgical Specialists

The Beryllium Corp.
National Precision Casting Div.

Bone Engineering Corporation

Brace, Inc.

B-Mold Division
Buckeye Brass Co.

Cadmet Corporation

California Precision Castings, Inc.

Casting Engineers, Inc.

Cercast, Inc.

Cooper & Schuber Co.

Nels Davies Dental Lab., Inc.

Earl Davis Production Engineering

Dean Precision Castings, Inc.

Deloro Stellite

Designed Precision Castings Ltd.

Engineered Precision Casting Co.

Gowin & Kelcher Investment Casting Co.

Gray-Syracuse, Inc.

Gross & Company, Inc.

Harcast Co., Inc.

Haynes Stellite Co.
Div. of Union Carbide Corp.

Hitchiner Manufacturing Co.

Howard Foundry Co.

Howe Sound Co.

Humphrey Castings, Inc.

Illinois Precise Casting Co.

Independent Steel Casting Co., Inc.

The International Nickel Co., Inc.

Intricast, Inc.

Investment Casting Co.

Jelrus Precision Casting Corp.

JOSEFF

Kaydee Metal Products Company

Kolcast Industries, Inc.

La Donn Castings, Inc.

Philip Laurence Co.

Lebanon Steel Foundry

Liebros Casting Co., Inc.

Lynn Casting Corp.

M & M Precision Casting Co.

Manco Products, Inc.

The Manell Company

Midwest Precision Castings Co.

Misco Precision Casting Co.

National Cast Products Co., Inc.

Newman Precision Casting Co.

Nilsen Mfg. Co.
Electronicast Div.

Northern Precision Casting Co., Inc.

Omni-Metal Castings, Inc.

Pacific Alloy Corporation

Perfect Casting

Pecco, Inc.

Precision Castparts Corp.

Precision Founders, Inc.

Precision Metal Co.

Precision Metalsmiths, Inc.

Ferro-Cast Division
J. B. Rea Company, Inc.

Reliable Toy Company Ltd.

Rex Precision Products, Inc.

Rimer Precision Casting, Inc.

Frank Roth Co., Inc.

Scot Engineering, Inc.

Scott Mfg. Co., Inc.

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Sigourney Mfg. Corp.

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Suffolk Precision Casting Co., Inc.

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Aviation Division
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Tectron, Inc.

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Truecast Precision Castings

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Fallon Industries Div.

Vascoloy-Ramet Corp.

Westinghouse Electric Corp.
Metals Plant

Witkin Precision Castings

York Castings, Inc.

Zenith Precision Casting Co.

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Advanced Jewelry Casting Co.

All Alloy Precision Cast

All Metal Precision Casting Corp.

Alloy Steel Casting Co.

Arrow Acme Corp.

Artco, Inc.

Arwood Corporation

Mercast Division
Arwood Corporation

Atlantic Casting & Engineering Corp.

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Bone Engineering Corporation

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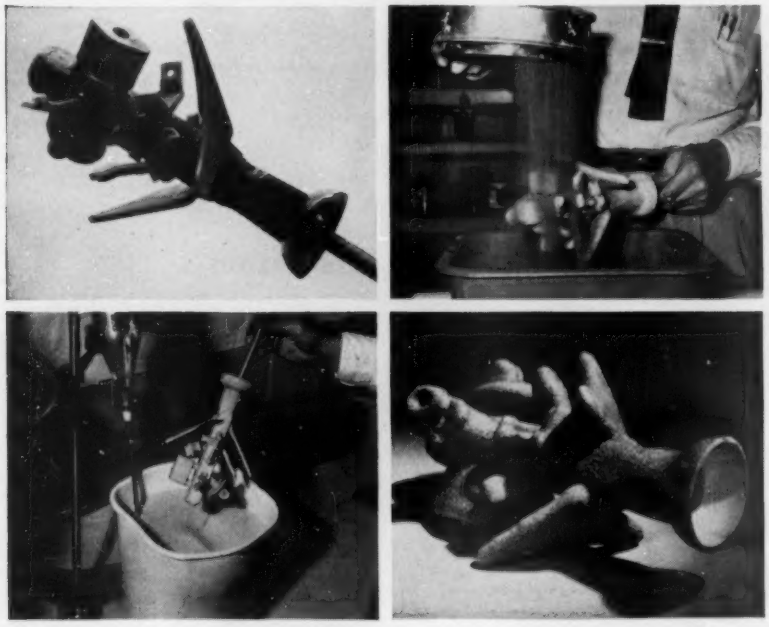

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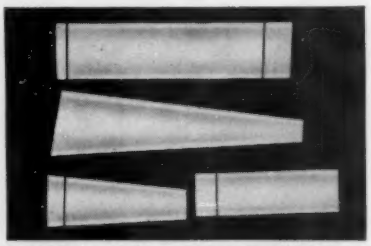

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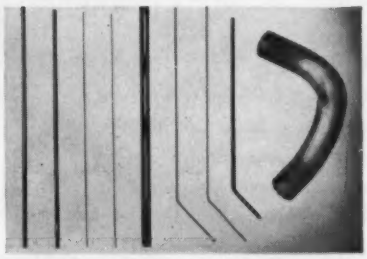

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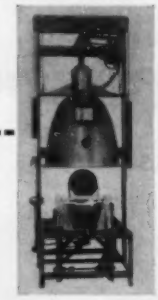

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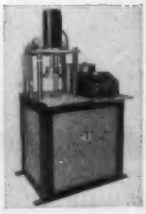

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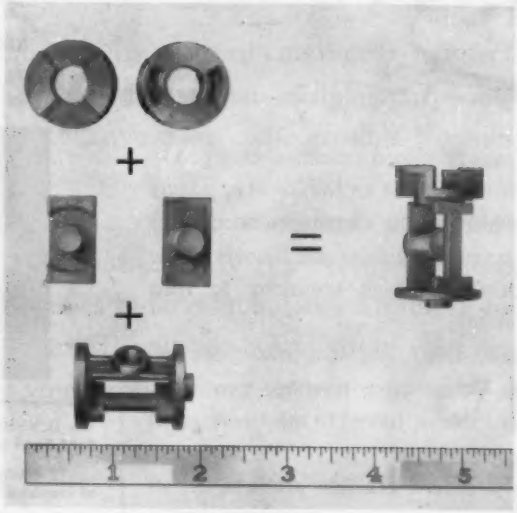

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Turbo Cast, Inc.
Universal Castings Corp.
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Vascoloy-Ramet Corp.
Witkin Precision Castings
York Castings, Inc.
Z & H Manufacturing Co.
Div. of General Casting Corp.
Zenith Precision Casting Co.

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A.L.A. Casting Company
Advanced Jewelry Casting Co.
Denton Precision Casting Co.
H. S. P., Inc.
Investment Casting Co.
National Cast Products Co., Inc.
Precision-Cast Products Co.
Rausch Manufacturing Co., Inc.
A. M. Schaler, Inc.

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Denton Precision Casting Co.
(Lead, Tin)
Lynch & Sons
(Lead)
Westinghouse Electric Corp.
Metals Plant (Alnico)
Vascoloy-Ramet Corp.
(Duronze, Tantung)

EQUIPMENT

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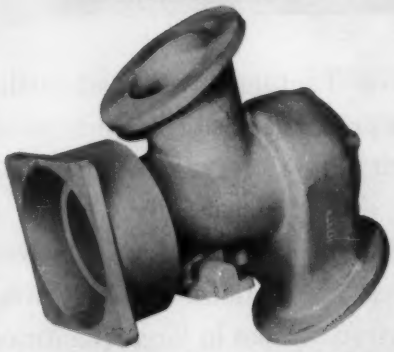
SIZE



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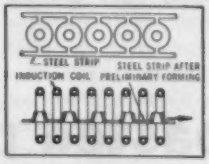
TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES

A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

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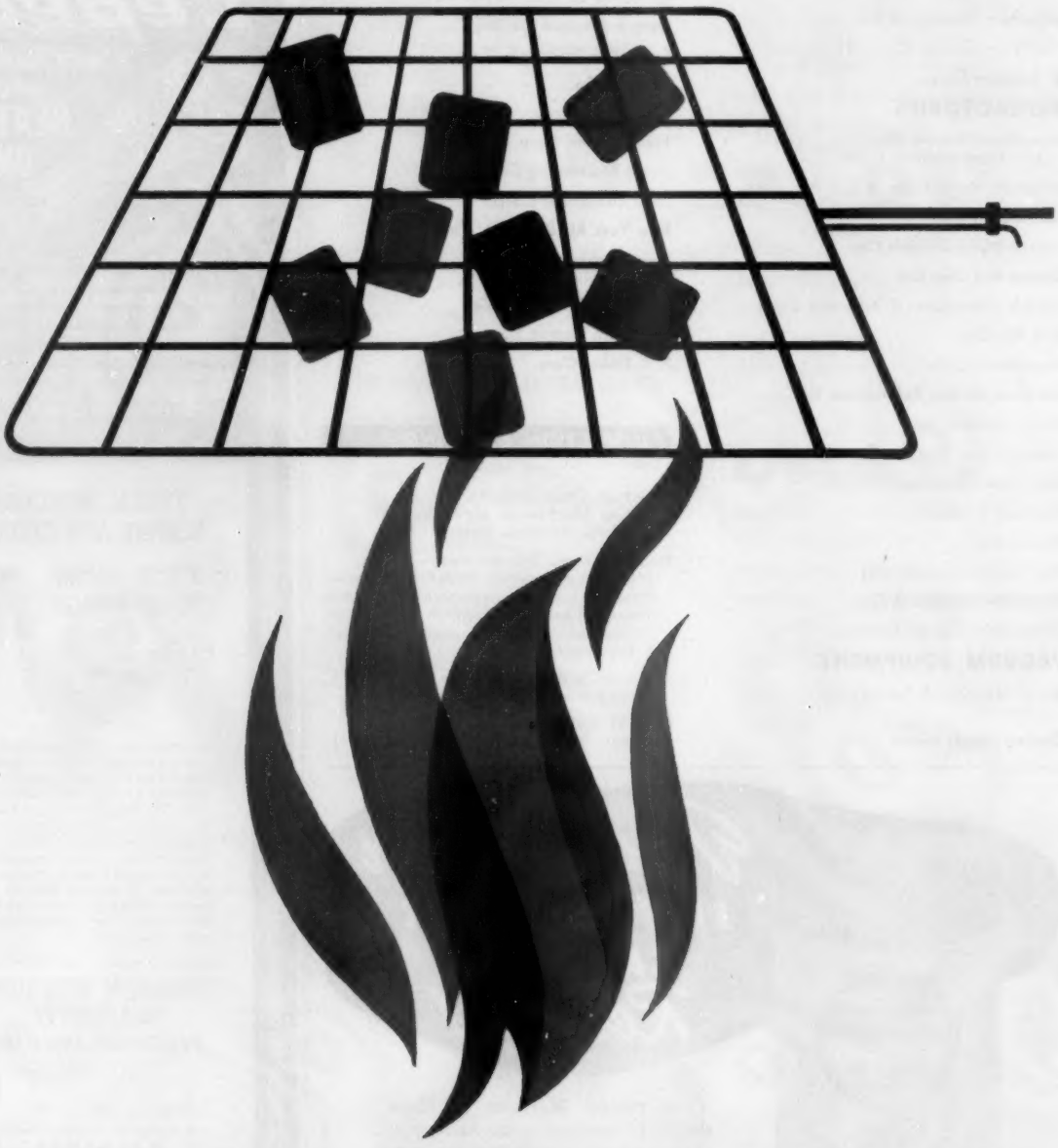

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Sherritt's recipe for making low-hydrogen nickel is as effective as it is simple: take pure nickel powder, press into uniform briquettes, and heat for a quarter of an hour at 1650°F. The result: pure nickel in its handiest form, with scarcely a trace of hydrogen. High-purity Sherritt nickel is also available in three standard grades of powder, special grades, and coated powders.

FOOTE MINERAL COMPANY *is the exclusive sales agent for Sherritt nickel and cobalt in the United States and Canada. For complete illustrated brochure with prices and delivery information, contact the Foote Mineral Company, 474S Eighteen West Chelten Building, Philadelphia 44, Pa.*

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"the HITCHINER way..."

...and non-machinable super alloys in INVESTMENT CASTING

These spray nozzles for highway striping paint sprayers were formerly machined out of cold rolled bar stock. When ordinary paint was used, these nozzles functioned satisfactorily. However, when ground glass was added to the paint for reflecting purposes excessive wear caused frequent replacement.

By "the HITCHINER way . . .", we were able to engineer the manufacture of this part by investment casting in a non-machinable type alloy exhibiting a very high degree of resistance to both wear and corrosion.

This change of alloy, which eliminated the need for frequent nozzle replacement, was made possible through investment casting because the required close dimensional tolerances and detail could be cast to size.

Through the wide freedom of choice in alloy, as well as through flexibility in design and the elimination of expensive machining operations, investment casting may possibly solve your metal parts manufacturing problems. Send us your sample or blueprint and find out with a Hitchiner "engineered quotation" — no obligation.

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Lebanon Precision Steel Castings offer the advantages of design flexibility, short lead time and low tooling costs

[redacted] *available in production quantities; ideally suited to prototype work*

The advantages of Lebanon's precision casting process

The Ceramicast Process, which is the production of precision steel castings from ceramic molds, has been brought to a high state of development at Lebanon Steel Foundry. For castings where the basic requirements are design intricacy, close tolerance control and surface finish, the process—alone or in combination with other methods—offers flexibility unobtainable by conventional precision casting methods, and affords remarkable savings in lead time and tooling costs.

FLEXIBILITY IN SIZE AND WEIGHT RANGE

The Ceramicast Process is not limited by the size and weight restrictions of other precision casting methods. Precision steel castings are produced at Lebanon in weights up to 300 pounds, and in a longest dimension up to 36 inches.

FLEXIBILITY OF ALLOY SELECTION

The Ceramicast Process at Lebanon permits the selection of a wide range of conventional and special steel alloys, as well as nickel and monel. These alloys, totalling 85 in number, are readily available from both large and small heats, and include precipitation hardening high alloys, austenitic corrosion resistant alloys, nickel base corrosion resistant alloys, and special purpose heat resistant alloys.

SAVINGS IN LEAD TIME

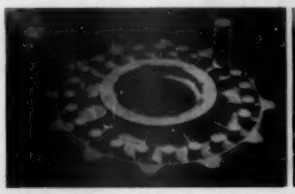
The preparation of ceramic molds for Lebanon precision steel castings is a relatively simple procedure. Small quantities of prototype parts can be produced within a few days after the original or pattern is received, making the Ceramicast Process highly advantageous in component development.

SAVINGS IN TOOLING COSTS

The Ceramicast Process utilizes wood or metal patterns. Wood patterns are desirable for prototypes, providing modification flexibility at comparative low cost, and in less time than is required by other precision methods.

Representative Lebanon precision steel castings

Pictured below are several steel castings representative of Lebanon's precision casting process. In each case, the castings are shown exactly "as cast," prior to any polishing or machining. The photographs are completely unretouched.



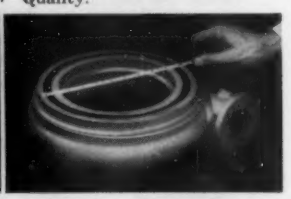
Casting for aircraft air conditioning system. Cast in a precipitation-hardening stainless alloy (AMS 5398; Ⓛ 17) to precise dimensional control and excellent reproduction of an intricate design. Class I X-Ray Quality.

Casting for flight control mechanism of the B-58. A high stress application, cast in a mildly corrosion-resistant alloy (AMS 5351B; Ⓛ12) and heat treated for high strength and hardness. Class I X-Ray Quality.

Manifold casting for missile. Cast in a high strength, low alloy steel (AISI 4140; Ⓛ 3) to precise dimensional control and contour. Class I X-Ray Quality.

Torque tube for aircraft brake system. Cast in a precipitation hardening stainless alloy (AMS 5398; Ⓛ 17) for a high stress application. Class I X-Ray Quality.

Gear train housing, for a directional control system. Cast to precise dimensional control, for a high load stress application, in a stainless alloy (AISI 431; Ⓛ 11) heat treated for high strength and hardness. Class I X-Ray Quality.



Turbine housing for missile. A controlled weight casting used in a missile propulsion system to handle hot gases at elevated temperatures (Hastelloy B; Ⓛ HB). Class I X-Ray Quality.

MAY WE HELP YOU? Write us for literature showing many other applications of Lebanon precision steel castings and our many services available to you in the successful solution of your design problem.

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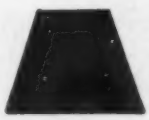

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10 sizes
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6 sizes
(¾" to 2")

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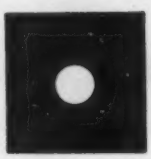
11 sizes
(¼" to 1¼")



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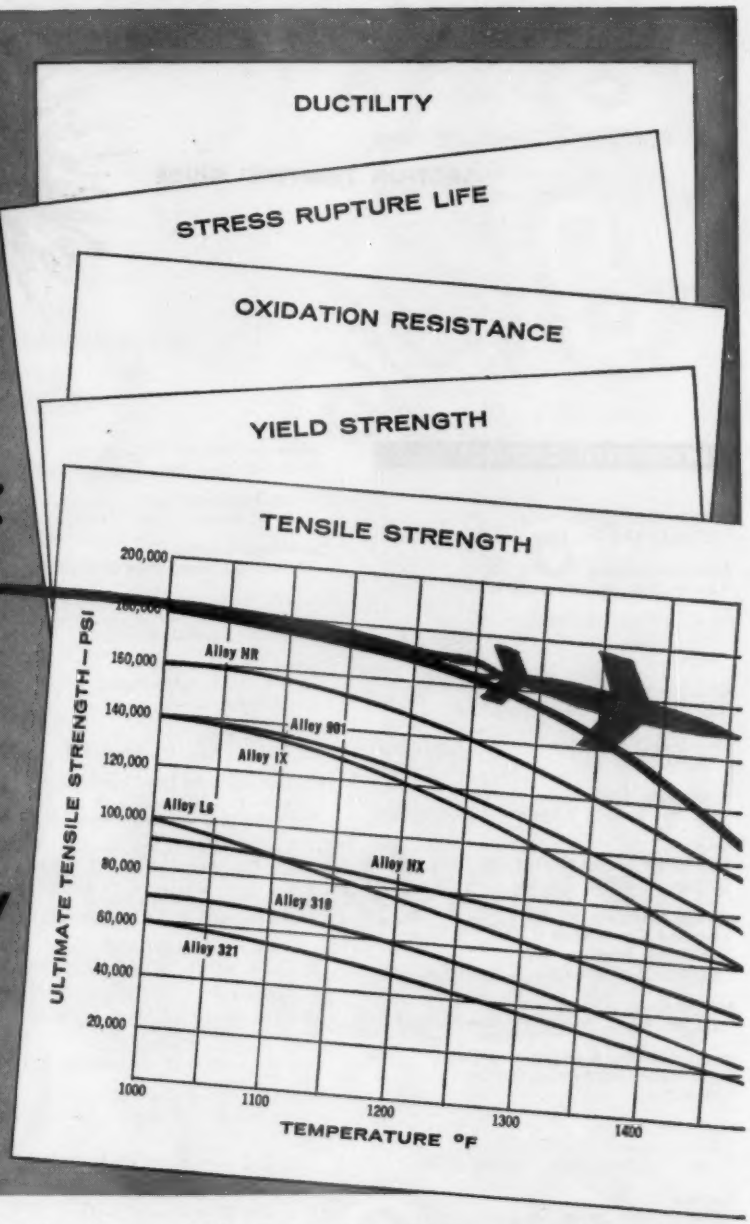

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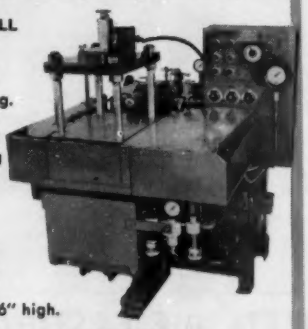

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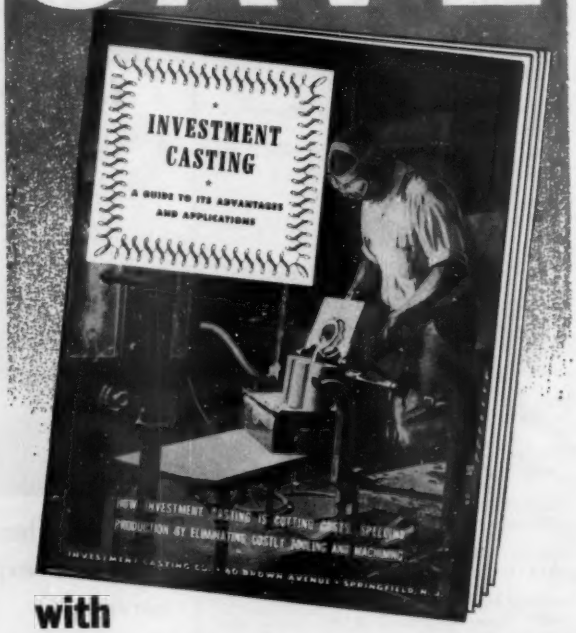

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Melville & Chicago Aves., P. O. Box 30,
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Vanadium-Alloys Steel Co.
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Vascoloy-Ramet Corp.
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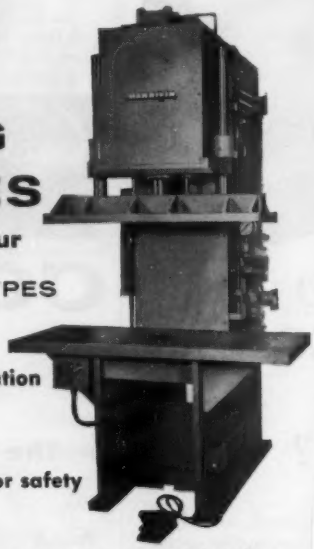
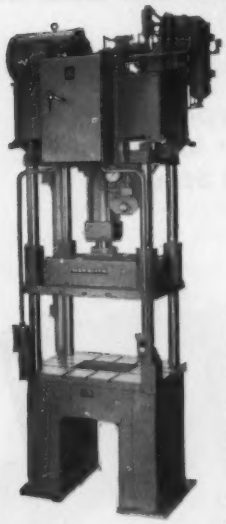
HYDRAULIC
DIE CASTING TRIM PRESSES

Give you more parts per hour

OPEN GAP OR COLUMN TYPES





- **High speed operation**
- **Easier set-up**
- **Longer die life**
- **Complete operator safety**
- **2 to 150 tons**

Faster Speeds • Lower Prices • Quick Delivery

YOU GET THESE FEATURES:

1. Safe, dual electric (or hand) controls
2. Automatic reverse on pressure or distance (adjustable)
3. Adjustable ram pressure
4. Extra-large tables standard
5. All-steel welded and stress-relieved construction
6. Hardened and chrome-plated rams and guide rods

For the full story of the advantages of high speed hydraulic trimming, send for our Bulletin 142. Or call in your Hannifin representative—he's a trained production analyst.

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581 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION
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DIE MAKERS — DIE CASTERS

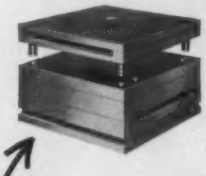
Standardize with D-M-E and Save!

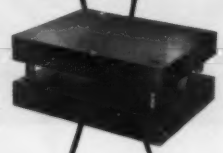
Reduce design time and cut die construction costs with these D-M-E STANDARDS—combined to fit your needs!

For added savings, start with D-M-E Standards—they're "better to begin with" because they're made of the finest steel, finish-ground flat and square. Only D-M-E Standards give you "custom-made" construction with the cost-saving benefits of standardized, interchangeable components.

RACK and PINION EJECTION

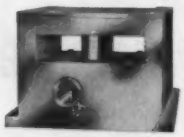
HYDRAULIC EJECTION





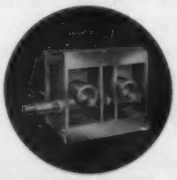
D-M-E Standard Cavity Retainer Sets

From 9⅞" x 8" to 23¾" x 35½"



D-M-E Standard EJECTOR BOXES up to 18" x 35½"

D-M-E Standard EJECTOR HOUSINGS up to 23¾" x 35½"



Welded Steel Construction (Patented)—30% lighter than cast-iron boxes!

Write for 170 page D-M-E Catalog, listing complete data and prices—or call or write your nearest D-M-E Branch TODAY for additional information.

58-E

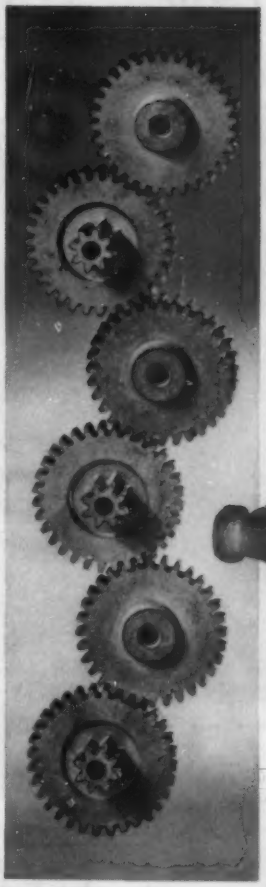
DME DETROIT MOLD ENGINEERING CO.

Contact Your nearest Branch for Faster Deliveries!

- DETROIT: 6686 E. McNichols Rd.—CHICAGO: 5901 W. Division St.
  HILLSIDE, N.J.: 1217 Central Ave.—LOS ANGELES: 3700 S. Main St.
- D-M-E CORP., CLEVELAND: 502 Brookpark Rd.—DAYTON: 558 Leo St.
- D-M-E of CANADA, Inc., TORONTO, ONT.: 156 Norseman Ave.

Circle No. 22 on Reader Service Card

BRONZE POWDER for GEARS that FIT THE JOB



CONTROL OF OUR DIMINISHING WATER SUPPLY DEMANDS EFFICIENT METERS IN GREATER NUMBER WITH FEWER AND BETTER OPERATING PARTS

Matching metal powder gears, supplied by a custom fabricator* ready for assembly, provide this ROCKWELL water meter gear train with friction-free operation, low parts cost, precision and durability.

Nonferrous powder metallurgy can produce accurate, low-cost components for your products as well.

*The PRESMET Corp., Worcester, Mass.

IT'S NEW!

WRITE TODAY FOR YOUR FREE COPY.

THE NEW JERSEY ZINC COMPANY
160 Front Street, New York 38, N. Y.

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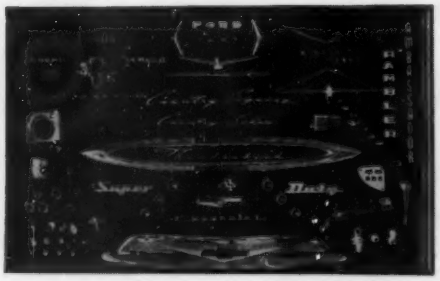
50 million castings a year from these

PUTTING THE NEW CARS IN TRIM FOR READY SALES

At the TRILEX CORPORATION, Wayne, Mich., this efficient battery of 14 KUX Hot Chamber Die Casting Machines (400- and 600-ton) is part of the complete Trilex facilities for modern die casting, fully automatic plating, finishing, and assembling.



KUX die casting machines

"THE PRIMARY concern of the major automobile manufacturers for die-cast trim parts is *quality*," says John Airey, president of Trilex Corporation, important suppliers in the automotive and appliance field. "That's why we have use KUX Die Casting Machines since 1945. They produce hardware finish quality castings.

"But along with quality," Mr. Airey continues, "auto makers as well as appliance men consider *price*. We've found that KUX machines can be depended on for minimum maintenance and minimum downtime. They put us in a better position to compete on a cost-per-unit basis."

Whether your main concern is lower production costs, higher quality or both, investigate the advantages of KUX Die Casting Machines. 28 all-new strain gauge proven KUX models, 50 to 2000 tons, for both hot or cold chamber operation, available with automatic cycling mechanism and KUX patented "Vac-U-Die" and "Auto Feed" systems of vacuum die casting.

Write for full details of the 28 all-new KUX models illustrated in the latest KUX Die Casting Machine Catalog.

KUX MACHINE CO.

6725 North Ridge Avenue, Chicago 26, Illinois

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2	20	38	56	74	92	110	128	146	164	182	200	218	236	254	272	290	308	326	344	362	380	398
3	21	39	57	75	93	111	129	147	165	183	201	219	237	255	273	291	309	327	345	363	381	399
4	22	40	58	76	94	112	130	148	166	184	202	220	238	256	274	292	310	328	346	364	382	400
5	23	41	59	77	95	113	131	149	167	185	203	221	239	257	275	293	311	329	347	365	383	401
6	24	42	60	78	96	114	132	150	168	186	204	222	240	258	276	294	312	330	348	366	384	402
7	25	43	61	79	97	115	133	151	169	187	205	223	241	259	277	295	313	331	349	367	385	403
8	26	44	62	80	98	116	134	152	170	188	206	224	242	260	278	296	314	332	350	368	386	404
9	27	45	63	81	99	117	135	153	171	189	207	225	243	261	279	297	315	333	351	369	387	405
10	28	46	64	82	100	118	136	154	172	190	208	226	244	262	280	298	316	334	352	370	388	406
11	29	47	65	83	101	119	137	155	173	191	209	227	245	263	281	299	317	335	353	371	389	407
12	30	48	66	84	102	120	138	156	174	192	210	228	246	264	282	300	318	336	354	372	390	408
13	31	49	67	85	103	121	139	157	175	193	211	229	247	265	283	301	319	337	355	373	391	409
14	32	50	68	86	104	122	140	158	176	194	212	230	248	266	284	302	320	338	356	374	392	410
15	33	51	69	87	105	123	141	159	177	195	213	231	249	267	285	303	321	339	357	375	393	411
16	34	52	70	88	106	124	142	160	178	196	214	232	250	268	286	304	322	340	358	376	394	412
17	35	53	71	89	107	125	143	161	179	197	215	233	251	269	287	305	323	341	359	377	395	413
18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	396	414

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12	30	48	66	84	102	120	138	156	174	192	210	228	246	264	282	300	318	336	354	372	390	408
13	31	49	67	85	103	121	139	157	175	193	211	229	247	265	283	301	319	337	355	373	391	409
14	32	50	68	86	104	122	140	158	176	194	212	230	248	266	284	302	320	338	356	374	392	410
15	33	51	69	87	105	123	141	159	177	195	213	231	249	267	285	303	321	339	357	375	393	411
16	34	52	70	88	106	124	142	160	178	196	214	232	250	268	286	304	322	340	358	376	394	412
17	35	53	71	89	107	125	143	161	179	197	215	233	251	269	287	305	323	341	359	377	395	413
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THIS PLANT (USES) (PRODUCES) ☐ TYPES OF PARTS CHECKED BELOW:

- ☐ Die Castings
- ☐ Extrusions
- ☐ Investment Castings
- ☐ Powder Metal Parts
- ☐ Permanent Mold Castings
- ☐ Plaster Mold Castings
- ☐ Shell Mold Castings
- ☐ None of these

DATA OFFERED IN THIS MONTH'S ADS

Qualified readers may obtain any of these free reference materials by circling the numbers on the Reader Service Cards

2 Stamping & Marking—Acromark Co.—Catalog—and price list on a line of stamping and marking machines.

4 Tool Steels—Allegheny Ludlum Steel Corp.—Technical literature—list describes 125 technical publications on tool steels.

7 Die Castings—American Smelting & Ref. Co.—Technical information—on electrolytically refined high grade zinc and other alloys for die casting.

9 Aluminum Alloys—Apex Smelting Co.—Brochure—lists the composition, mechanical properties and heat treatments of standard aluminum alloys.

10 Investment Casting—Arwood Corp.—44-page manual—"Practical Guide to Investment Casting."

11 Piston Rings—Auto-Diesel Piston Ring Co.—Catalog—lists plunger rings, tips, liners and combination tip-rings.

12 Die Casting Machines—B & T Machinery Co.—Catalog—gives complete specifications on a line of high-pressure, hot and cold chamber die casting machines.

13 Compacting Presses—Baldwin-Lima-Hamilton Corp.—Technical data—on compacting presses for large, high density, close tolerance parts.

15 Investment Casting—Centrifugal Casting Supply Co.—Technical bulletins—describe investments, a vacuum mix, automatic industrial injector and other products.

17 Die Casting Machines—Cleveland Automatic Machine Co.—Technical data—on a line of high-speed die casting machines from 100 to 2000 ton capacities.

19 Investment Casting—Corning Glass Works—Information—on Glascast mold and core material which feature an extremely low coefficient of thermal expansion.

22 Standardized Die Components—Detroit Mold Engineering Corp.—170-page catalog—describes standardized die components which reduce design time and cut die construction costs.

24 Die Castings—Dollin Corp.—16-page facilities brochure—describes and illustrates die casting services, facilities and equipment.

25 Tool & Die—Gentry Carbide Tool & Die Co.—6-page brochure—shows their equipment for making carbide tools and dies.

26 Metal Powder—The Glidden Co.—Technical literature—describes the Resistox Metal Powders that are prepared by a special process which removes all soluble salts.

27 Small Die Castings—Gries Reproducer Corp.—Technical data—on small zinc alloy die castings.

28 Zinc Die Casting—Henning Bros. & Smith, Inc.—Engineering data—on die casting with zinc alloys.

29 Investment Casting—Hitchiner Mfg. Co.—13-page booklet—explains the ceramic shell investment casting process and shows their facilities.

32 Die Casting Machines—Hydraulic Press Mfg. Co.—Information—on a complete line of hot and cold chamber die casting machines from 100 to 2000 ton capacities.

35 Induction Heating—Lepel High Frequency Laboratories, Inc.—Catalog—describes a line of high frequency induction heating equipment.

36 Sinterings—Merriman Bros., Inc.—Technical bulletin—and catalog on highest quality, dimensionally accurate sinterings.

40 Sinterings—New Jersey Zinc Co.—Technical manual—tells how to design for pressed brass and nickel silver metal powder parts.

41 High Vacuum Furnace—Kinney Mfg. Div., New York Air Brake Co.—Technical literature—on a high vacuum furnace that melts pieces up to 50 lbs.

42 Trim Presses—Hannifin Co.—Technical literature—lists specifications and advantages of open gap or column type trimming presses.

43 Sinterings—Reese Metal Products Corp.—Brochure—tells how to cut precision parts cost with the Remet powdered metal process.

44 Alloy Powder—Republic Steel Corp.—Technical booklet—gives engineering data and test results on medium high strength alloy powder MHS 6450.

45 Ladles & Skimmers—Spincraft, Inc.—Technical data—and price list for stainless steel ladles and skimmers.

46 Compacting Presses—F. J. Stokes Corp.—Data sheet—on single-station, multiple motion compacting presses with secondary lower motion.

49 Steel Finishing Balls—Abbott Ball Co.—Technical Bulletin AP-1—describes barrel finishing media for producing mirror-like finishing.

50 Chemical Finishing—Allied Research Products, Inc.—Data file—on process chemicals for the metal finishing industry.

51 Painting Equipment—Conforming Matrix Corp.—Bulletin—describes electroformed masks, automatic painting machines, part and mask fixtures, and mask washers.

53 Vibratory Finishing—Roto-Finish Inc.—Technical booklet—describes the Vibratron for precise finishing of castings.

66 Die Casting Machines—Lester-Phoenix, Inc.—Specifications—on a complete line of die casting machines.

70 Mold Lubrication—Pierce-Waller Inc.—Data sheet—on the Air-Lube system for cleaning and lubricating mold surfaces.

71 Investment Castings—Scott Casting & Mfg. Co.—Literature—on the complete range of sizes and alloys cast by standard investment and wax shell techniques.

72 Dry Acid—Enthone Div. Amer. Smelt. & Ref. Co.—Technical data—on water soluble dry Enth-Acid 82 for cleaner activated surfaces and shorter plating times.

74 Crucibles—Denver Fire Clay Co.—Catalog—gives full information on a line of crucibles and funnels for the casting industry.

75 Die Casting Machines—Kux Machine Co.—Catalog—gives complete specifications on a line of 28 die casting machines.

78 Low-Hydrogen Nickel—Sherritt Gordon Mines Ltd.—Brochure—gives prices and delivery information on Sherritt nickel and cobalt.

85 Investment Castings—Humphrey Castings, Inc.—34-page facilities brochure—explains the investment casting process and shows some of its applications.

86 Investment—Kerr Mfg. Co.—Catalog—describes Duracast, a nonferrous investment, and other industrial products.

88 Casting Alloys—WaiMet Alloys Co.—Technical data—on casting alloys tailored to particular end uses.

89 High Temperature Alloy—Cannon-Muskegon Corp.—Technical bulletin No. 86—gives data on Rene 41, an alloy for use in the 1200°-1800°F. range.

91 Wax Shapes—Yates Mfg. Co.—Technical literature—describes a complete line of wax shapes for investment casting.

94 Investment Castings—Investment Casting Co.—Booklet—tells how to cut costs, speed production and reduce machining with investment casting.

96 Investment Casting—Misco Precision Casting Co.—External House organ—includes news of latest processes and case histories of special investment castings.

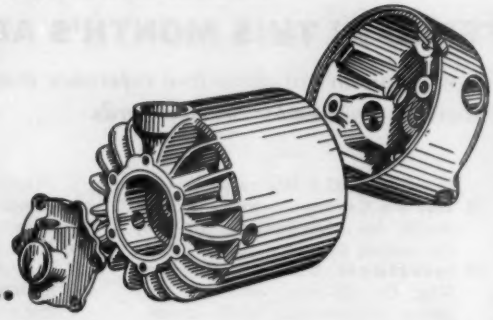
97 Investment Casting—Misco Precision Casting Co.—I.C.I. handbook—tells how to design and buy investment castings.

98 Investment Casting—Misco Precision Casting Co.—16mm movie—for technical groups—shows investment casting methods, tooling, gaging, engineering problems and representative castings.

continued on page 95

Circle No. 37 on Reader Service Card

It takes "More Than a Machine" to Produce GOOD Die Castings...



and MILWAUKEE has what it takes!

Among other needed factors, it takes a staff of trained die casting engineers . . . skilled die designers . . . die builders . . . machine operators . . . plus an intimate knowledge of the die casting process, its limitations and possibilities. Most important, it takes the kind of *know how* acquired only through years of specialization in the design and production of die castings in many shapes and sizes for thousands of different applications.

A pioneer of the die casting industry, Milwaukee offers everything you need for the production of fine die castings . . . completely modern plant facilities . . . highly skilled technicians . . . and more than 50 years of continuous service to die casting users throughout industry.

Milwaukee operates under the Certified Zinc Plan of the American Die Casting Institute.

Milwaukee has a separate plant for the production of Lead and Tin Die Castings.

MILWAUKEE DIE CASTING COMPANY
4146 N. HOLTON STREET • MILWAUKEE 12, WISCONSIN
Established 1909

4th in a series of POWDERED METAL PARTS applications by REESE

when **SERVICE** and **KNOW-HOW** count as much as **ECONOMY**

3 Remet Powdered Metal Parts go into Sargent & Greenleaf

FILE CABINET LOCKS

(A) PLUG
(B) FILLER
(C) BOLT

According to Mr. George Paul, Chief Engineer, Sargent & Greenleaf, Inc., "A number of powdered metal parts producers were contacted to make these low cost, close tolerance, complex parts. Reese was the only one interested. We now find other practical applications and will, of course, use Reese as our prime source".

Formerly a zinc base die casting . . . now sintered brass for a higher melting point for use on insulated files.

FREE BROCHURE
"How to Cut Precision Parts Cost with the Remet Powdered Metal Process" shows how the Reese Corp. can help you. Send for your copy today.

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REESE METAL PRODUCTS CORPORATION
537 Howard Ave., Lancaster 10, Penna.

Gears • Pinions • Cams • Ratchets
Oilless Bearings • Bushings • Machine and Structural Parts in
COPPER • BRASS • IRON • ALLOY STEEL • NICKEL SILVER • COPPER INFILTRATED IRON

Circle No. 43 on Reader Service Card

DIE ALIGNMENT (cont.)

formation in order to grind the control faces and restore alignment, without any loss in mating accuracy.

Several dies have been constructed in this manner (figure 2) and are an improvement over the dowel pin type.

Advantages of this system are:

1. Perfect alignment regardless of temperature.
2. Mismatch of the cavities can be corrected by merely grinding the control surfaces.
3. The pins do not decrease the die surface available because they are located on the edge not on the face.
4. The location or alignment of the pins is not critical as only the surface toward the die does the locating.
5. The pins can be made of rough flat stock that has been ground on one surface.
6. The pins can be easily replaced or moved to a new location.
7. There are no dowel holes to trap splashed metal.
8. No accurate hole spacing or boring is necessary.
9. Two or more bolts can secure the pin to the locating surface.

REDESIGN (cont.)

corrosion problems since there is very little electro-chemical action between steel and aluminum and between steel and brass. This improvement can not, of course, be measured in percent or in dollars, but only in customer satisfaction.

After machining all of the die cast aluminum parts are given a chromate (Iridite) treatment. This serves as a passivating surface treatment on parts not painted and as a good paint base.

PMM OPPORTUNITIES

jobs & equipment

POSITIONS OPEN

MASTER DIE CASTER with proven supervisory experience wanted as partner to establish new eastern shop with substantial assured aluminum die cast business. Supply resume of educational background, experience, and previous earnings in first letter. Your confidence respected. Box 5360.

ASSISTANT TO SALES MANAGER—To perform liaison function between sales and customers concerning engineering and production matters. Competency and experience in oral and written communications important. Experience with sales or engineering in investment castings desired. Precision Castparts Corp., 4600 S.E. Harney Drive, Portland 6, Oregon.

TOOLROOM FOREMAN—Well established, Eastern, custom die casting company requires an experienced Toolroom Supervisor. The man we are seeking is probably a former diemaker with a minimum of 5 years supervisory experience. This is an excellent opportunity for qualified man. Please submit resume giving experience and salary requirements. All replies will be answered and treated confidentially. Box 6160.

ENGINEER—ASSISTANT CHIEF DIE CASTING DESIGN—Medium size die casting plant requires Assistant Chief Design Engineer. Responsibilities would include estimating cost of castings, dies and secondary tools from blueprints, supervision of design and construction, subcontracting tool work to outside shops. Man we seek should have engineering background and 5-8 years practical experience. Excellent opportunity. Please submit resume and salary requirements. All replies will be acknowledged and held confidential. Box 6260.

TOOLING SUPERVISOR—A progressive, expanding investment casting company on the West Coast, undertaking many unusual and advance projects, has opening for an experienced tooling supervisor. Must possess a high degree of skill in scheduling, print interpretation, die sinking and die estimating. This is a growth position in modern facilities with many fringe benefits, including profit sharing. Send resume to Box 6360.
DIE CAST ENGINEER experienced in designing and estimating. Capable of managing department. Write giving full particulars. Hampden Brass & Alumimun Co., 262 Liberty St., Springfield, Mass.

PROCESS ENGINEER—Aggressive Southern California Investment Foundry, ferrous and non-ferrous, offers opportunity to engineer, with successful investment casting background, who has tooling, metallurgical or process development experience. For interview send resume to Rex Precision Products, Inc., 11825 Major St., Culver City, California.

DIE CAST FOREMAN WANTED: for new progressive aluminum and zinc die casting plant in Southeast. Must have background in volume production of zinc and aluminum die castings. Be able to take complete charge of casting department. Reply giving education, experience and salary requirements. P. O. Box 6560.

DIE CAST TOOL AND DIE MAKER WANTED: to take charge of tool and die department of new progressive die casting plant in Southeast. Must have good background in die building and die maintenance. Real opportunity for right man. Reply giving education, experience and salary requirements. P. O. Box 6660.

EXPERIENCED SALES REPRESENTATIVE for Wisconsin and another for Indiana to handle Chicago, long established, quality job shop, zinc and aluminum die casting service on commission basis. Give details and lines carried. Write Box 6460.

FOR SALE

INVESTMENT CASTING EQUIPMENT—Wax injectors, 20 lb. arc furnaces, belt grinders, dust collectors, Magnaflux unit, 2150° globar furnace. Near new. Offers accepted. H. W. Hulver, 10512 Sherer Road, Lees Summit, Missouri.

100 Ton Cleveland Zinc Die Casting Machine, Model 50, Serial No. 3006. This machine has recently been reconditioned and performs very well. Asking price—$3,000. Los Angeles Die Casting Co., 340 Crocker St., Los Angeles 13, California—Phone MAdison 4-0901.

for quality castings

Electrolytically refined TADANAC Brand Special High Grade Zinc, is a high quality product that means efficient, trouble-free performance from your casting units. With TADANAC Brand you can be sure of uniform quality, reliable supply and prompt delivery. Further assistance is readily available from our Technical Service Staff, who are fully conversant with the zinc die-casting industry. For your convenience TADANAC Brand Special High Grade slabs have just been re-designed to travel better and handle easier.

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Toronto WORLD'S LARGEST LEAD-ZINC PRODUCER Montreal

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D168

Circle No. 20 on Reader Service Card

EXHIBITORS LITERATURE FROM M.P.I.F. SHOW

For those who missed the Metal Powder Industries Federation show in Chicago, here's a list of exhibitors' literature which was available. *Use the reader service card facing page 90.*

---

259 Iron Powders—Crane Co.—Engineering data—on the current grades of Plast-Iron metal powders.

260 Iron Powders—Crane Co.—11-page brochure—on iron powder tells how its made and used.

261 Iron Powders—Crane Co.—Engineering data—shows the strength and growth properties of Plast/Iron grade B-261.

262 Alloy Powder—Republic Steel Corp.—14-page engineering report—on the properties of medium high strength alloy powder type MHS6450.

263 Alloy Powder—Republic Steel Corp.—23-page engineering report—on the properties of high strength type 6460 alloy powder.

264 Nickel Powder—Sherritt Gordon Mines Ltd.—Brochure—describes the facilities and products of the mining and engineering divisions.

265 Nickel Powder—Sherritt Gordon Mines Ltd.—Information—on the price and delivery of grades C, F and S nickel powders.

266 Nickel Powder—Sherritt Gordon Mines Ltd.—13-page engineering report—on the sintering and alloying properties of nickel-coated metal powders.

267 Metal Powders—Sherritt Gordon Mines Ltd.—16-page technical brochure—describes the facilities and and metal powders available.

268 Sinterings—National Sinter-Seal Co.—Technical booklet—discusses the sealing of pores in sintered metal parts.

269 Sinterings—National Sinter-Seal Co.—Brochure—describes a unit for the sealing of powdered metal parts in your own plant.

270 Graphite—Joseph Dixon Crucible Co.—Brochure—tells how Air-Spun graphite improves the strength and speeds the production of powdered metal parts.

271 Graphite—Joseph Dixon Crucible Co.—Brochure—tells where colloidal natural graphite can be used.

272 Graphite—Joseph Dixon Crucible Co.—Technical bulletin—gives a general description of colloidal natural graphite products and their uses.

273 Sintered Brass—Witco Chemical Co.—12-page engineering report—on the effects of lithium stearate additions and various atmospheres on sintered brass compacts.

274 Dry Lubricant—Witco Chemical Co.—Brochure—describes Impalpable Calcium Stearate M dry lubricant.

275 Dry Lubricant—Witco Chemical Co.—Brochure—describes Impalpable Zinc Stearate M free flowing, non-agglomerating dry lubricant.

276 Metallic Stearates—Witco Chemical Co.—36-page technical booklet describes the properties and uses for metallic stearates.

277 Endothermic Generators—Ipsen Industries, Inc.—Technical data—on gas and electric endothermic generators designed to supply carrier gas to controlled atmosphere heat treating units.

278 Heat Treating Furnace—Ipsen Industries, Inc.—Technical data—on the Series V-5-750 automatic high vacuum heat treating furnace.

279 Heat Treating Furnace—Ipsen Industries, Inc.—Technical data—on the Series V-300 automatic, high vacuum, cold wall type, heat treating furnace.

280 Heat Treating Furnace—Ipsen Industries, Inc.—Technical data on the Series VVFC-10 x 14 automatic, high vacuum, cold wall type, heat treating furnace.

281 Vapor Pressures—Ipsen Industries, Inc.—Chart—lists the vapor pressures of the elements at various temperatures.

282 Heat Treating—Ipsen Industries, Inc.—7-page engineering report—on the effect of temperature uniformity in heat treating.

283 Bearings—The United States Graphite Co.—7-page engineering bulletin—describes the properties of Gramix bronze bearings.

284 Bearings—The United States Graphite Co.—Technical brochure—lists the design requirements and metallurgical considerations for producing sintered bearings.

285 Machine Parts—The United States Graphite Co.—Technical brochure—lists the design advantages and metallurgical requirements for powdered metal machine parts.

286 Sinterings—Chicago Powdered Metal Products Co.—Facilities brochure—lists the advantages of buying their sinterings.

287 Powdered Metal Blenders—General Machine Co. of N.J.—Brochure—shows the Economizer System for efficient loading and unloading of conical blenders.

288 Dust-Tite Valves—General Machine Co. of N.J.—Brochure—tells why leading manufacturers use Gemco spherical dust-tight valves.

289 Blenders & Dryers—General Machine Co. of N.J.—40-page booklet—gives all the facts on custom designed blenders and vacuum dryers.

290 Coulter Principle—Coulter Industrial Sales Co.—ASTM Technical Publication—explains the Coulter Principle for the electronic measurement of subsieve particle size and distribution.

291 Coulter Counter—Coulter Industrial Sales Co.—Brochure describes the Coulter Counter for the electronic measurement of subsieve particle size and distribution.

292 Compacting Presses—F. J. Stokes Corp.—Engineering data—on dual-pressure 300-ton hydraulic compacting presses.

293 Compacting Presses—F. J. Stokes Corp.—Engineering data—on air-operated, multiple motion compacting presses in the low and medium pressure range.

294 Compacting Presses—F. J. Stokes Corp.—Specifications—on a complete line of single punch and rotary compacting presses.

295 Iron Powder—Alan Wood Steel Co.—Information—on the shipping, delivery and application of A. W. iron powder.

296 Iron Powder—Alan Wood Steel Co.—Technical data—on A. W. iron powder includes screen and chemical analysis.

297 Sinterings—Hoeganaes Sponge Iron Corp.—Engineering data—on the sintered properties of Ancor MH-100 and Ancor 80 iron-copper-carbon mixes.

298 Compacting Press—Baldwin-Lima-Hamilton Corp.—Specifications—and general description of a 75-ton, mechanical compacting press.

299 Compacting Press—Baldwin-Lima-Hamilton Corp.—Specifications—and general description of a 200-ton, mechanical compacting press.

300 Iron Powders—Easton Metal Powder Co.—Technical data—on Easton RZ molding, electrode, and cutting iron powders.

301 Metal Powders—Vanadium-Alloys Steel Co.—Technical data—on pre-alloyed metal powders includes information on tooling design and materials.

302 Compacting Presses—Kux Machine Co.—Brochures—describe a line of compacting presses from 10 to 500 tons.

304 Compacting Presses—Kux Machine Co.—Technical data—on the features and control systems of their compacting presses.

305 Compacting Presses—Kux Machine Co.—ASTE technical paper—on the advancement in mechanical and hydraulic compacting press design for modern compacting techniques.

306 Compacting Presses—Mannesmann-Meer, Inc.—Specifications—on Bussmann-Simetag hydraulic compacting presses up to 200 tons.

307 Sintering Furnaces—The Drever Co.—Literature—on a complete line of sintering furnaces, from batch-type to roller hearth.

308 Ammonia Dissociators—The Drever Co.—Technical data on ammonia dissociators and anhydrous ammonia.

continued on next page

M. P. I. F. LITERATURE *(cont.)*

309 **Tooling**—A. Johnson & Co.—Technical report—"Withdrawal Tooling for Compacting Powdered Materials."

310 **Compacting Presses** — A. Johnson & Co.—Literature—and specifications on the Soenen compacting presses from 44 to 220 tons.

311 **Compacting Techniques**—A. Johnson & Co.—Technical report—on the influence of lubrication and die surface on the pressing characteristics of metal powders.

312 **Testing**—A. Johnson & Co.—Technical report—"Can Sintered Steel Be Evaluated From Machined Blanks?"

313 **Magnetic Sinterings** — A. Johnson & Co.—Technical data—on the magnetic properties of sintered HVA standard electrolytic iron powder.

314 **Sintered Properties**—A. Johnson & Co. — Technical report — on the mechanical properties of double pressed MSS standard grade sinterings.

315 **Metal Powders** — The New Jersey Zinc Co.—Literature—on the nominal compositions and sieve sizes of available metal powders.

316 **Sinterings**—The New Jersey Zinc Co. — External house organ — discusses the winning designs in the contest for the best applications of nonferrous powder metallurgy.

317 **Nitrogen Generator** — Lindberg Engineering Co.—Technical bulletin—on a fully automatic, dry process generator of high purity nitrogen.

318 **Sinterings**—Lindberg Engineering Co.—Technical bulletin—on a complete line of sintering furnaces and atmosphere generators.

319 **Carbon Control** — Lindberg Engineering Co. — Literature — on the Carbotrol unit which automatically controls the carbon potential of furnace atmospheres produced by endothermic type generators.

320 **Metal Powders** — Charles Hardy, Inc.—Price list—for VASCO prealloyed and stainless Steel powders.

321 **Tool & Die** — Cleveland Tool and Die Co.—Brochure—shows the facilities and services offered.

DATA IN ADS. *(cont.)*

99 **Investment Casting**—Misco Precision Casting Co.—Technical brochure—shows Misco's unique equipment, includes tables of alloy properties.

100 **Investment Casting**—Misco Precision Casting Co.—Bulletin—details the control requirements for investment casting quality control.

102 **Investment Casting**—Misco Precision Casting Co.—Bulletin—on the dimensional control of investment casting.

103 **Investment Casting**—Misco Precision Casting Co.—Bulletin—shows how to get dimensional accuracy with intricate shapes by design and gage control.

104 **Ceramic Shell Casting**—Misco Precision Casting Co.—Brochure—tells of the advantages of investment casting in ceramic shell molds.

105 **Vacuum Investment Casting**—Misco Precision Casting Co.—Booklet—tells how hard-to-machine alloys can often be vacuum investment cast.

106 **Soluble Cores**—Misco Precision Casting Co.—Bulletin—tells how soluble cores permit increased freedom of design for investment castings.

107 **Investment Casting**—Misco Precision Casting Co.—Report—on the investment casting of parts that cannot be made any other way.

108 **Investment Casting**—Misco Precision Casting Co.—Bulletin—on the preparation of patterns, molds, the Mono-Shell process, X-ray inspection, and finishing.

109 **Quoting Investment Castings**—Misco Precision Casting Co.—Bulletin—tells how to quote on the production of investment castings to meet performance demands.

110 **Molybdenum**—Climax Molybdenum Co.—110-page manual—on molybdenum metals. Technical booklet tells how molybdenum's resistance to mineral acids may solve your corrosion problems.

111 **Die Steel**—Latrobe Steel Co.—Data sheet—shows why VDC hot work die steel can mean better die casting dies.

112 **Crucibles**—Vesuvius Crucible Co.—Brochure—details the advantages of ALUmelt crucibles for melting and holding aluminum.

DIE CASTERS RENEW PROTEST OF PRICE DISCRIMINATION

Price discrimination in the Reynolds Metals–Ford–General Motors "hot metal" aluminum contracts was termed unfair to independent custom die casters recently at opening sessions of the hearings on the problems of small business in the aluminum industry. The hearings are being conducted by Subcommittee No. 3 of the House Select Committee on Small Business, headed by Rep. Sidney R. Yates (Dem., Ill.).

Speaking in behalf of more than 100 independent aluminum die casting producers, Richard E. Kellers, Associate Secretary of the American Die Casting Institute, stated that the Reynolds "hot metal" price discrimination persists although it has been under investigation by the Department of Justice and Federal Trade Commission since the previous aluminum hearings by the Yates Subcommittee in 1958.

Mr. Kellers claimed that the effect of the price preference cited in the Reynolds contracts has been to encourage vast expansion of the die casting facilities of Ford and General Motors with a resultant large increase in the aluminum die castings they make for themselves and a severe drop in the tonnage of aluminum die castings they buy from independent die casters.

In the absence of relief through the Justice Department or the FTC, the independent die casters are, according to Kellers, forced to conclude that existing legislation is inadequate to afford protection against this kind of price discrimination which can cause foreclosure of a principal market for independent die casters. Accordingly the die casters are requesting the assistance of the House Select Committee on Small Business in providing remedial legislation.

TAYLOR TO REPRESENT BOHN ALUMINUM

Robert L. Taylor has been appointed Sales Representative for Bohn Aluminum & Brass Corporation for the Rochester-Buffalo-Syracuse area, it was announced by R. C. Aylward, vice president-sales. Mr. Taylor will represent all of Bohn's product line, except heat transfer products. The Bohn district office is at 207 Burke Building, 5 St. Paul Street, Rochester 4, New York.

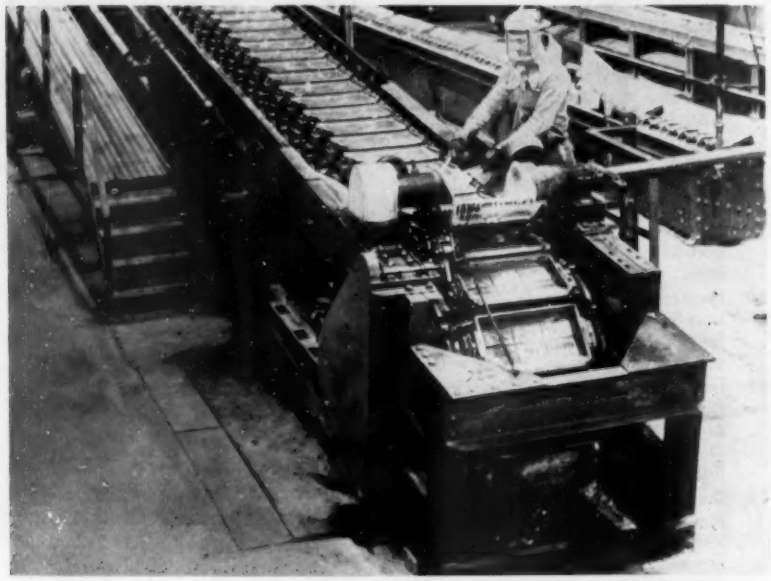
SPECIALIZED ELECTRONIC TO REPRESENT BRUSH

The Brush Beryllium Company, a producer of beryllium metal, alloys and compounds, announces the appointment of The Specialized Electronic Corporation to market beryllium-containing alloys in the Southeastern United States.

Specialized Electronic—with offices in Birmingham, Alabama, Orlando and Cocoa Beach, Florida—will represent Brush in Alabama, Florida, Georgia, North and South Carolina.

INDUSTRY NEWS

(Continued from page 26)



LOBECK TO MARKET SHEPPARD INGOT CASTING MACHINES

Lobeck Casting Processes Inc. has announced the conclusion of a marketing agreement with Sheppard & Sons, Ltd., British manufacturers of ingot casting machines for ferrous and non-ferrous metals.

Under the terms of the agreement, Lobeck can now offer its customers in the United States the most advanced designs of ingot and pig casting machinery. This complementing its own line of fully continuous and semi-continuous billet, slab, and bar casting equipment. The range of ingot casting machines covers both single and multiple-strand units, to handle such metals as iron, aluminum, zinc, lead, copper, nickel, and their alloys. The firm's booster-driven zinc slab casting machine has been particularly successful and is today regarded as standard equipment the world over.

AMERICAN ZINC INSTITUTE MOVES

The American Zinc Institute, Inc. will occupy new and larger offices at 292 Madison Avenue, New York 17, N.Y. The new AZI phone number will be OREgon 9-6020.

According to John L. Kimberley, executive vice president of AZI, the Institute's new and expanded facilities will enable it to serve more efficiently those industries producing and using zinc and zinc-coated products.

American Zinc Institute, Inc., a non-profit organization, is the national trade association of the zinc industry. One of its major functions is the collection and distribution of information relative to the production and use of zinc and zinc-based alloys and compounds.

WELDING HANDBOOK SECTION III AVAILABLE

Publication of the Third Section of the Fourth Edition of the Welding Handbook is announced by the American Welding Society. The cloth-bound, 512 page volume contains 335 illustrations, 78 tables, and a very comprehensive index. Special welding and metal joining processes are covered, as well as arc cutting processes.

The book is available from the American Welding Society, 33 West 39th St., N.Y. 18. List price $9.00.

LILLEGREN

AUSTIN T. LILLEGREN DIES

Austin T. Lillegren, 67, Vice President of Madison-Kipp Corporation, Madison, Wisc., died of cancer Saturday, May 14 in a Madison hospital. Burial was in Roselawn Memorial Park in Madison on May 16.

Austin, as he was known to his countless friends throughout the die casting industry, joined Madison-Kipp as Sales Manager in 1918 and became Vice President in 1944. He was born in Minneapolis, Minn. and was Munition Sales Manager of Hart-Parr Co. of Charles City, Iowa during World War I. He served in the Army Ordnance Department in 1945 as a member of the combined intelligence team for the European Theatre for which he received a Certificate of Commendation.

Mr. Lillegren was highly active in American Die Casting Institute activities for many years and served as National President of ADCI from 1951 to 1953. In 1956 he received the Annual Doehler Award for outstanding service to the die casting industry. He was presently serving as Chairman of the Die Casting Research Foundation and on the ADCI Board of Directors.

ICI CERAMICS COURSE FOR INVESTMENT CASTING

Dr. Willis G. Lawrence (left), chairman of the Department of Ceramic Research, talks with Richard R. West (right), Associate Professor of Research, about Differential Thermal Analysis equipment at the College of Ceramics.

The Investment Casting Institute in cooperation with Dr. W. G. Lawrence, Chairman of Alfred University's College of Ceramics, has developed a four day course in "Ceramics for Investment Casting." The course will be held at Alfred University, Alfred, New York, June 14-17, 1960. Richard Lordi, Foundry Department, General Electric Company, and E. M. Baker, Corning Glass Works, Co-Chairman of ICI's Education Committee, are cooperating with Dr. Lawrence in the preparation of the course.

The course is open to members of the ICI, and to a limited number of engineers and technical representatives from non-member firms. It is designed to provide technical and operating personnel in the precision casting field with fundamental information concerning the investment materials which are used. The properties of refractory materials used as aggregates, the chemistry, limitations and applications of the various binders, the factors involved in the compounding of aggregate-binder systems, drying and heating of molds and metal-mold reactions.

The fee for the course is $130.00 plus $40.00 for room and board. Housing will be in the University dormitories. For reservations write Dr. W. G. Lawrence, College of Ceramics, Alfred University, Box 122, Alfred, N.Y. Include a check for $130 with each reservation.

HUGH EXTRUSION PRESS

The largest self-contained aluminum extrusion press ever built will be installed by Reynolds Metals Company in its Grand Rapids, Mich., extrusion plant.

The 4,000-ton press is expected to be in production by mid-summer, according to L. H. Graves, Jr., general manager of Reynolds extrusion division.

The plant's cast house already has been expanded in preparation for set up of the press.

The new press is being built for Reynolds by Lake Erie Machinery Corporation, Buffalo, N.Y. Reynolds and Lake Erie cooperated in design of the equipment. Lake Erie has been a manufacturer of hydraulic presses for metal processing industries for 30 years.

The extrusion press is operated by a compact oil-hydraulic system which is an integral part of the equipment. Older type presses operate on a complex water-hydraulic system, much of which is auxiliary equipment. The water-hydraulic presses also require installation of special water systems.

ALUMINUM EXTRUSIONS EXPANDS

Aluminum Extrusions, Inc. of Charlotte, Mich., has enlarged its quality control department and increased production capacity by approximately 25 per cent.

W. E. Dunlap, AE president, announced completion of the company's expansion program.

AE added 40,000 square feet of manufacturing space to accommodate production and plant improvements.

The company installed a 1,500-ton Loewy Hydropress with an automatic transfer, a plant-wide conveyor system, and automatic painting, silk screening, and polishing facilities. The new equipment gives AE three large extrusion presses, complete finishing facilities, mechanized handling, and even more efficient flow of materials and parts.

Also newly installed is a pilot color-anodizing line for process analyses and sample runs of new sections before production runs.

CASTING SUPPLY HOUSE MOVES TO LARGER QUARTERS

Robert Greenbaum, president of Casting Supply House, announced that the firm moved and is now located in its new and larger quarters at:

62 West 47th St.
New York 36, N.Y.
JUdson 6-0290

A modern showroom where the latest casting equipment and supplies will be displayed, is open to all.

NEW FEDERAL METAL CO. PLANT

The Federal Metal Co., a manufacturer of brass and bronze ingots, will soon move into new and greatly enlarged quarters in Cleveland.

The new plant has 65,000 sq. ft. of usable space, almost three times the space available in the present quarters. Three clear spans assures adequate space for the most efficient layout.

Offices and laboratories are housed in a wing of the main building. Over 100 sq. ft. of laboratory space are available for both routine analysis and inspection and for research and development.

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HUDSON BAY

SPECIAL HIGH GRADE ZINC — 99.99%

International Minerals and Metals Corp.

11 Broadway
New York 4, N.Y.

One Fine Zinc For Die Casting

Circle No. 33 on Reader Service Card

If it's service you're after..

call a Hoover Man

If you want the kind of service featured in this cartoon, we aren't making any promises. But if you want service in quality aluminum and zinc alloy castings, you'll come to the right place if you come to Hoover. We've been satisfying the die-casting demands of many different industries for 35 years. Let one of our Sales Engineers tell you about us. Why not today?

HOOVER

THE HOOVER COMPANY, Die Casting Division, North Canton, Ohio Die Casting specialists since 1922

In Canada — Hamilton, Ontario

DIE CASTING *by* HOOVER

Circle No. 31 on Reader Service Card

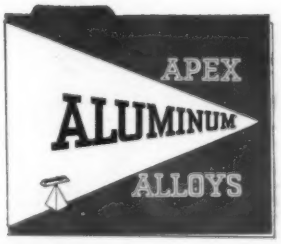
APEX ALLCAST 70

An Aluminum Alloy that assures consistent high quality with economy

A general-purpose aluminum alloy, Allcast 70 offers superior mechanical properties as well as worthwhile savings through higher yields.

Pressure tightness, high fluidity with absence of shrinkage are assured by rigid technical control of all steps in its production.

Allcast 70 has delivered uniform performance in millions of pounds of sand and permanent mold castings produced over the past 15 years. Superior products such as Allcast 70 are a specialty of Apex . . . a name foundries know they can rely on every time.



Send for our brochure, "Apex Aluminum Alloy," which lists composition, mechanical properties and heat treatments of standard Apex products. No obligation.

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